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RADIOLOGY

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EDITOR

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A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Radiation Therapy of Neuroblastoma[1]

WILLIAM B. SEAMAN, M.D., and MARK D. EAGLETON, M.D.

THE PROGNOSIS of children with neuroblastoma has shown remarkable improvement in recent years. All of the early reports emphasized the rapid course and fatal termination. Farber (5), in 1940, was the first to report that cures could be obtained. Despite the bizarre natural history of this neoplasm, which includes spontaneous regression (2, 7, 22) and maturation into a more differentiated benign form (11, 19, 25), we feel that the improved outlook is due chiefly to the intelligent use of x-ray therapy. Although surgical excision may be curative when no distant metastases are present (1, 10, 15), frequently the tumor is unresectable, so that only biopsy or partial removal is feasible (13, 18). Thus, one must rely in most instances upon radiation therapy as the chief therapeutic agent.

During the interval from July 1949 to July 1955, 19 patients with neuroblastoma were treated at the Mallinckrodt Institute of Radiology. All patients referred for radiotherapy were accepted for treatment, and in all the diagnosis was confirmed microscopically. Seven of the 19 patients have lived for periods varying from ten to seventy-six months (Table I). Five patients survived from forty-five to seventy-six months, a three-year survival rate of 26 per cent. The role of surgery in this group has been for diagnostic purposes only, with a single exception (Case 4), in which all grossly visible tumor was excised. Although this patient received postoperative irradiation, the case is more properly classified as a surgical cure.

TABLE I: CHILDREN WITH NEUROBLASTOMA SURVIVING FOLLOWING RADIATION THERAPY

Patient	Age (mos.)	Sex	Primary Site	Metastases	Survival (mos.)
J. L. J.	13	M	Mediastinum	Long Bones Orbit Skull	63
M. M.	16	M	Mediastinum	None	53
T. S.	17	F	Mediastinum	None	45
R. M.	2	M	Abdomen	None	76
D. L.	6	M	Abdomen	Hepatic	54
M. G.	11	M	Mediastinum	None	25
H. T.	16	M	Abdomen	Lung Long Bones	10

Phillips (19) reported a 17 per cent three-year survival for 58 cases receiving radiation therapy. Wittenborg (25) stated that 30 per cent of 73 patients survived for a similar period, and Snyder (21) reported 3 three-year survivals among 24 cases. Thirty-one per cent of Uhlmann's 19 patients lived for three years (24). Combining these series, we thus have a 23 per cent survival of a total of 174 patients.

The 5 patients in our series who have survived for three years include one with histologically verified osseous metastases and another with microscopic evidence of

[1] From the Edward Mallinckrodt Institute of Radiology, Washington University School of Medicine, Saint Louis, Mo. Accepted for publication in April 1956.

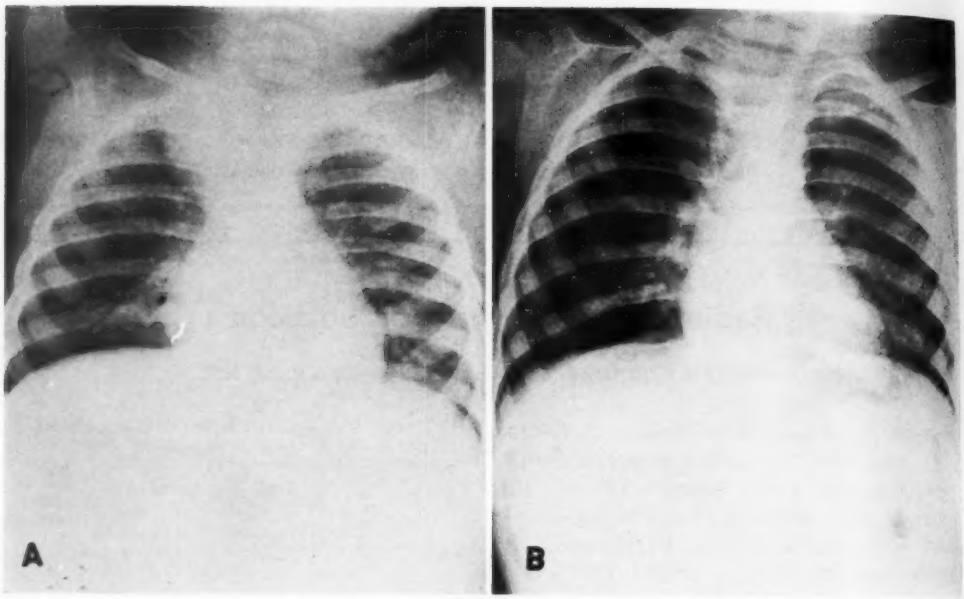

Fig. 1. Patient J. L. J. A. Chest roentgenogram showing large superior mediastinal mass extending into right upper lobe. B. Roentgenogram taken fifteen months following the completion of x-ray therapy, showing complete disappearance of the tumor.

liver metastases. Although cures have been recorded in cases with metastases to the liver (25), reports of recovery in the presence of skeletal metastases have been rare. None of Wittenborg's patients with skeletal metastases survived for longer than a year. Farber (6) reported regression of skeletal metastases in 3 cases, following treatment with Aminoanfol, triethylenemelamine, and cortisone respectively. Goldring (7) in 1951 described an abdominal tumor in a six-months-old infant, involving the liver, with roentgen evidence of metastases in the right humerus and skull. The child made a complete recovery following x-ray therapy to the abdomen. The skeletal involvement apparently disappeared spontaneously. Anderson (2) reported the case of an infant of seven months with an abdominal neuroblastoma and roentgen evidence of femoral metastases, who recovered without any treatment except ACTH. A histologically verified neuroblastoma of the proximal femur was seen by Stewart (22), in a young infant. Although there was no other evidence of disease, he felt that this represented a metastasis rather than primary neuroblastoma. X-ray therapy was directed to the femur only, and the child remained well for fourteen years. Because of the paucity of patients with bone metastases surviving five years or longer, we are describing a case in detail.

CASE REPORT

J. L. J., a 13-month-old white male infant, entered the hospital because of protrusion of the left eye. One month earlier the child had fallen and struck the left eye, with resultant orbital swelling and discoloration. The swelling persisted and exophthalmos developed. For two weeks the mother had observed weakness of the legs, more marked on the left, with unsteadiness in walking. For one week there had been fever and vomiting, without nausea.

Examination at the time of admission to the St. Louis Children's Hospital, Jan. 12, 1951, revealed proptosis of the left eye and a firm, non-tender mass in the left orbit. The left pupil was dilated and did not react to light directly but did so consensually. The abdomen was negative to palpation.

Laboratory studies disclosed a hypochromic microcytic anemia with 9 gm. of hemoglobin and a normal white blood cell count and differential count. A smear of bone marrow taken from the

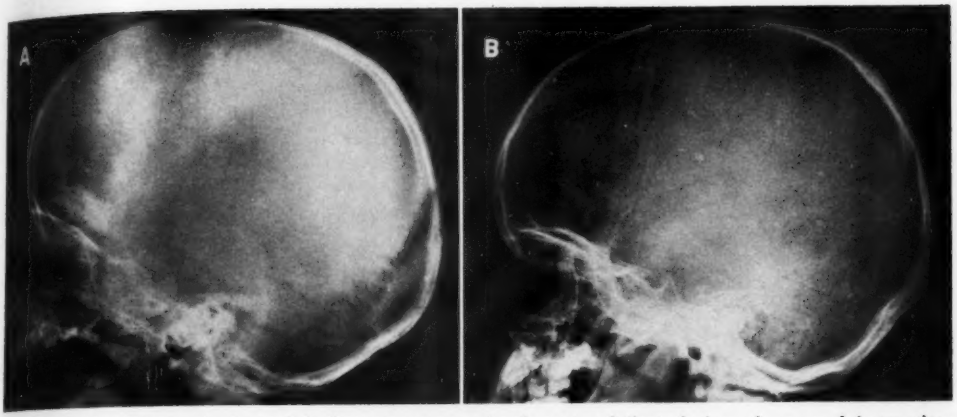

Fig. 2. Patient J. L. J. A. Lateral skull roentgenogram showing sutural diastasis, irregular area of destruction, and osteoblastic reaction in the frontal bone. B. Skull roentgenogram taken two years later is normal.

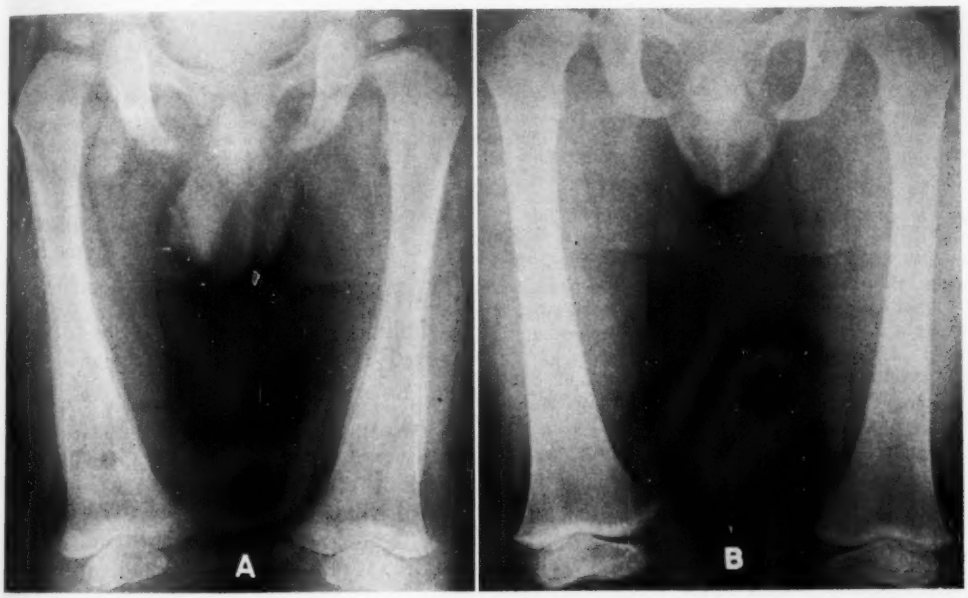

Fig. 3. Patient J. L. J. A. Roentgenogram of the femora showing extensive diaphyseal periosteal reaction bilaterally and an irregular area of bone destruction distally in each. B. Normal roentgenogram taken fifteen months following x-ray therapy.

right tibia revealed many large mononuclear cells with purple nuclei and several nucleoli and a variable amount of blue-staining cytoplasm. These were thought to be tumor cells, and the diagnosis of neuroblastoma was suggested. This was confirmed by histologic sections of bone marrow from the right tibia. A smear of bone marrow taken from the right iliac crest was normal except for myeloid and erythroid hyperplasia.

Roentgen examination of the chest disclosed a superior mediastinal mass extending into the right upper lung field (Fig. 1). The skull showed sutural diastasis and a large irregular mottled area of bone destruction involving the left frontal bone and left orbit (Fig. 2). Roentgenograms of the skeleton revealed areas of destruction in the shafts of both femora (Fig. 3), the left humerus (Fig. 4), and both tibiae, associated with extensive periosteal reaction. The x-ray diagnosis was mediastinal neuroblastoma with metastases to the long bones, skull, and orbit.

Fig. 4. Patient J. L. J. A. Roentgenogram of left arm showing periosteal reaction involving humerus and an irregular area of bone destruction in the proximal diaphysis. There are questionable periosteal changes in the proximal radius and ulna. B. Fifteen months following roentgen therapy these bones are completely normal.

External roentgen therapy was begun on Jan. 19, 1951, to a 10 × 10-cm. portal over the left frontal region, including the orbit, and a 5 × 10-cm. area over the anterior mediastinum. One field was treated daily, for a dose of 150 r in air, with 200-kv equipment at a 50-cm. target-skin distance and a h.v.l. of 1.0 mm. Cu. After a total of 2,000 r in air were delivered to each of these two fields, 800 r in air were given to both tibiae, the left humerus and forearm, and the right humerus, through 12 × 7- and 10 × 5-cm. areas, with daily increments of 400 r. The left femur received 1,050 r in air. The total treatment time was forty-seven days. The child tolerated therapy well and improved steadily. Several transfusions were necessary to control the anemia. After one month he was eating normally and had begun to walk again. Two months after the completion of therapy, he was completely well and examination was negative except for epilation over the left anterior scalp. Roentgenograms showed evidence of healing and regression of the osseous metastases. It is now over five years since the beginning of therapy, and the patient has remained in excellent health. The roentgen abnormalities have completely disappeared.

All of our patients who died did so quite soon following therapy, usually without even an initial transient remission. Although it has been stated that a one-year survival is equivalent to a five-year survival in the average adult cancer, a number of cases of neuroblastoma have been reported in which death occurred from three to six years following treatment, including one from our series, recently reported by Kissane and Ackerman (11).

DIAGNOSIS

Roentgenograms may be of great diagnostic value in neuroblastoma, particularly when there is evidence of a mass containing calcium and displacing the kidney. Roentgenographically demonstrable calcification is rare in intrathoracic neuroblastomas but occurs in 45 per cent of the abdominal tumors. If bilateral symmetrical metastases to bone are also present, the roentgen diagnosis is more reliable. Sherman and Leaming (20) have made a detailed study of the roentgen appearance of the bone metastases. They point out that the areas of destruction are primarily medullary and well defined, with a varying amount of cortical destruction, and tend to be bilaterally symmetrical. In the skull, the classical appearance is one of sutural separation, perpendicular spiculation with

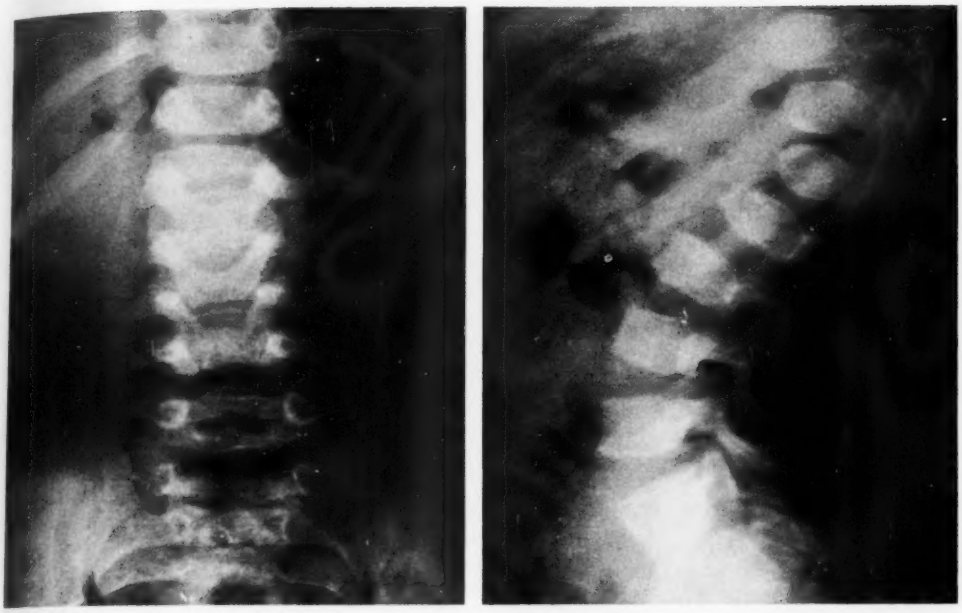

Fig. 5. Anteroposterior and lateral views of the lumbar spine of Patient R. M. six years following abdominal irradiation. Although radiation changes are present in the vertebral bodies of T-12, L-1, 2 and 3, the marked lordosis was thought to be largely the result of fibrosis and atrophy of the erector spinae muscles.

patchy osteoblastic and osteolytic changes in the vault.

A definitive diagnosis can be made only by microscopic examination, and even then may be difficult. When the tumor is highly undifferentiated, it may be misdiagnosed as a lymphosarcoma (1). Typical neuroblastoma cells may be found in the bone marrow even in the absence of demonstrable skeletal metastases, but misdiagnoses of leukemia have been reported (23)

PRINCIPLES OF THERAPY

The neuroblastoma is one of the few malignant tumors in which aggressive therapy is justified regardless of the extent of its dissemination. Occasionally, children with widespread metastases may be cured. Wittenborg has reported 6 patients with liver metastases surviving for three years or more after x-ray therapy. It is our conviction that extensive disease is not in itself a contraindication to irradiation and that no patient should be denied a trial of roentgen therapy. Although there have appeared in the literature sporadic cases in which metastases disappeared following irradiation of the primary site, we do not believe this occurs often enough to justify withholding treatment of the distant lesions. Phillips (19) states that irradiation of the metastases and not of the primary tumor does not increase survival, although he did obtain a longer survival when only the primary growth was irradiated and not the metastases. Our policy is to treat all known foci of disease. Postoperative irradiation should not be used routinely, but is indicated only when surgical removal is considered incomplete.

Most neuroblastomas are radiosensitive. Cures have been obtained with as small a tumor dose as 400 r in sixteen days (25). Wittenborg points out that almost all of his patients who survived without complications of treatment received initial tumor doses of 800 to 1,200 r in ten to fourteen days, usually followed by a second series of treatments in three months. Phillips found a tumor dose of 2,000 to 3,000 r in ten to twenty days adequate in most cases.

We believe that treatment must be individualized according to the response of the tumor and the general condition of the patient. The tumor doses in our surviving children have varied from 1,300 to 3,000 r, delivered in twenty-two to fifty-five days. With the development of marked leukopenia or debilitation, therapy should be temporarily discontinued. Wyatt and Farber (27) strongly urged that careful consideration be given to the clinical status of the patient undergoing irradiation, lest the immediate reactions of treatment defeat the ultimate purpose. Gross (8) mentioned 2 patients who died with pancytopenia and extensive bone marrow depression.

LATE COMPLICATIONS OF THERAPY

With increasing numbers of long-term survivals, we can expect to see more late sequelae of radiation damage to adjacent normal tissues. Such effects may be unavoidable if clinical cure is the goal.

It has been demonstrated that 2,300 r delivered to the entire extent of both kidneys in a five-week period may result in radiation nephritis, renal failure, and death (14). The tolerance of the spinal cord, according to Boden (4), is in the range of 4,500 r depth dose in seventeen days for small fields and 3,500 r in seventeen days for large fields. The influence of radiation on growing bone is well known, and numerous instances of deformities due to retarded bone growth following radiation therapy have been described (3, 17). A child who died four years following therapy had developed a moderate scoliosis and radionecrosis of several ribs (11). Neuhauser (17) suggests that scoliosis may be minimized if the entire width of the vertebral body is included within the field of irradiation. Another child developed a marked lumbar lordosis six years after irradiation to the retroperitoneal area through anterior and posterior fields. This infant was given a tumor dose of 3,120 r in twenty-three days at the age of two months through 10 × 10-cm. areas. Although the growth of the vertebral bodies was retarded, the lordosis seemed to be due chiefly to fibrosis and atrophy of the lumbar erector spinae muscles (Fig. 5).

FACTORS AFFECTING PROGNOSIS

It is of some interest to note that all 7 of our surviving patients were seventeen months old, or younger, at the time therapy was begun, while the average age of those who died was forty-two months. Seven of the 9 survivals reported by Phillips were in children not over fourteen months. Six of the 7 survivors in Uhlmann's series ranged from five days to nine months of age. Koop *et al.* (12) reported 17 of 44 patients alive, although only 12 (27 per cent) had survived for fourteen months or longer. The average age of the surviving patients was four and three-quarters months as compared to an average age of thirty-four months for the patients who died. The average age of 3 surviving patients reported by Pack (18) was five months as compared to an average age of three years for his entire group. Gross found the survival rate under twenty-four months to be 45 per cent, while that for children over twenty-four months was 11 per cent. Although this may merely reflect the greater incidence of the disease during the first year of life, it also suggests a better prognosis in this age group.

In assessing the results of therapy, it is impossible to evaluate the possible influence of the processes of maturation and spontaneous regression. Phillips suggests that the tendency towards spontaneous regression or differentiation into a benign ganglioneuroma may be enhanced by a variety of agents, including x-ray therapy, nitrogen mustard, cortisone, antifolics, and surgical trauma (biopsy or partial removal) and recommends the utilization of all available therapeutic agents. Uhlmann believes that in some patients radiation therapy may not destroy all of the tumor cells present but may initiate cellular changes leading to maturation and control of the disease. Hicks (9) has demonstrated in experimental animals that the neuroblast

is the only radiosensitive cell in the developing nervous system. Radiation may simulate maturation by destroying all of the neuroblasts so that the only residual cells are the more resistant ganglion cells. From the clinical standpoint, the important fact is that, regardless of the mechanism leading to survival, a significant number of patients may be saved.

SUMMARY

1. Five of 19 patients with neuroblastoma survived three years or longer following radiation therapy.

2. Two of the surviving patients had histologically verified metastases, one involving liver and the other involving multiple bones.

3. A high survival rate seems to occur in the younger age group.

4. Because of occasional survivals of patients with metastases, extensive disease should not be a contraindication for radiation therapy.

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(*Summario in interlingua al pagina sequente*)

SUMMARIO IN INTERLINGUA

Therapia Radiational de Neuroblastoma

Ex 19 patientes recipiente radiotherapias pro neuroblastoma in le curso de un periodo de sex annos, 5 superviveva tres annos o plus, e duo viveva al fin del sex annos post minus extense intervallos. Un caso de superviventia cinquenne es reportate in detalio. Un patiente, de dece-tres menses de etate al tempore de su prime presentation, habeva metastases al ossos longe, al cranio, e al orbita. Un del altere superviventes habeva metastases al hepate.

Alte procentages de superviventia es a expectar in patientes del plus juvene gruppos de etate. Nulle del superviventes in le presente serie de patientes habeva plus que dece-septe menses de etate quando le therapia esseva initiate, sed le etate medie del patientes qui moriva esseva quaranta-duo menses. Le autores adhere al principio de irradiar omne cognoscite focos del morbo. In lor patientes supervivente le doses de radiation variava ab 1.300 a 3.000 r, applicate al tumores in le curso de inter vinti-duo e cinquanta-cinque dies. Proque il occurre casos de superviventia in infantes con metastases, le extension del morbo non deberea esser considerate como indication contra le irradiation.

An Evaluation of the Roentgen Manifestations of Isolated Ventricular Septal Defect[1]

THEODORE E. KEATS, M.D., VAN ALLEN KREIS, M.D., and ELLEN SIMPSON, M.D.

ACCUMULATED experience in the roentgen study of congenital heart disease has made possible a re-evaluation of previously established diagnostic criteria. The problems of differential diagnosis no longer are matters of academic interest only, but have, as well, connotations of practical surgical importance. This study was undertaken to re-evaluate the roentgen signs of isolated ventricular septal defect and to determine which of these signs may be useful in its differentiation from other cardiac conditions.

REVIEW OF LITERATURE

Uncomplicated ventricular septal defect accounts for 8 per cent of all congenital cardiac malformations and ranks fifth in order of frequency (1). Once thought to be a lesion of little clinical significance, it is now recognized as a possible cause of severe and disabling heart disease. The patients whose lesions are classified as *maladie de Roger*, characterized solely by the classical murmur and thrill, constitute only a small percentage of those with ventricular septal defect (1–4). It has been shown that it is the size and not the position of this defect which determines the clinical and roentgen changes (5).

The roentgen change usually described is cardiac enlargement involving both ventricles, associated with enlargement of the pulmonary artery and peripheral pulmonary vessels (6–11). Although left ventricular enlargement is almost always present, various authors differ as to the frequency with which it can be determined roentgenographically when the right ventricle is also enlarged (4, 9, 12, 13). Until recently, enlargement of the left atrium has been described infrequently in isolated ventricular septal defect (14–16). Wood *et al.* (1) and Kjellberg *et al.* (4) have shown, however, that left atrial enlargement is a frequent finding and one which is useful in differential diagnosis.

MATERIALS AND METHODS

The clinical charts and roentgenograms of 20 patients with isolated ventricular septal defect were reviewed. In 19 of these the diagnosis was proved with reasonable assurance by catheterization and in 1 by autopsy. The former group was studied by physicians working in the Vascular Research Laboratory of the University of California.

Because passage of the catheter through the septal defect at the time of catheterization is the exception rather than the rule, several diagnostic criteria were established in the selection of cases for this study: (*a*) The oxygen content of blood from the right ventricle and pulmonary artery must be at least 1.0 volumes per cent higher than that from the right atrium and the venae cavae. This showed the presence of an interventricular septal defect. (*b*) There must be no indication of right-to-left shunt as evidenced by arterial oxygen content. (*c*) There must be no signs of other malformation.

All cases which fell into the group of "Eisenmenger complex" were excluded. The limits of this category are not sharply defined and it may include cases of isolated ventricular septal defect. Most authors now use this designation in the physiologic rather than in a strict anatomic sense, to include not only patients with overriding aorta but also those with isolated ventricular septal defect and pulmonary hypertension in which there is right-to-left shunting of blood. This broadened concept of the "Eisenmenger complex" became necessary because of the difficulty in determining minimal degrees of overriding of the aorta

[1] From the Department of Radiology and the Vascular Research Laboratory of the University of California School of Medicine, San Francisco, Calif. Accepted for publication in April 1956.

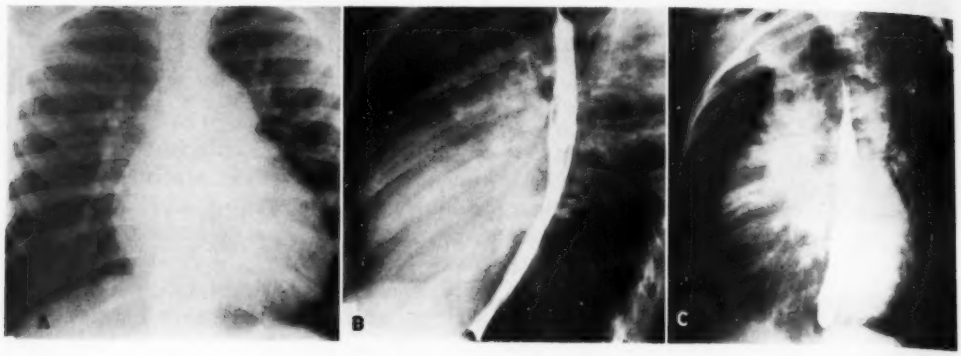

Fig. 1. Postero-anterior, left lateral, and left anterior oblique roentgenograms of the chest of an 8-year-old girl with ventricular septal defect showing right and left ventricular and minimal left atrial enlargement.

TABLE I: ROENTGEN FINDINGS IN 20 PATIENTS WITH ISOLATED VENTRICULAR SEPTAL DEFECT ARRANGED IN ORDER OF INCREASING AGE

	Age In Years	Sex	Cardiac Enlargement	Lt. Vent. Enlargement	Rt. Vent. Enlargement	Lt. Atrial Enlargement	Main Pulmonary Artery Enlargement	Hilar Vessel Enlargement	Aortic Enlargement	Increased Pulmonary Vascularity	Pulmonary Vein Enlargement
D. S.	6 mo.	F	++	0	++	+++	++	++	0	++	0
S. M.	2	F	++	0	+++	+	+++	+++	0	+++	+
K. F.	5	F	++	++	+	+	++	++	0	+++	0
M. W.	5	F	++	++	+	0	+++	++	0	++	0
J. M.	6	M	++	++	+++	+	++	++	0	++	++
S. S.	6	F	++	++	++	+	+++	+	0	+	+
A. C.	6	M	+++	+++	+	0	+	+	0	+	++
M. M.	6½	F	++	++	+	+	++	+	0	+	0
S. D.	7	F	+	+	+	0	++	++	0	++	++
M. G.	7	F	+	0	++	+	0	+	0	+	0
B. M.	9	M	++	0	+	0	++	++	0	+	0
G. N.	9	M	+	+	+	0	++	+	0	0	+
B. R.	11	F	0	0	0	0	+++	++	0	++	+
S. B.	11	M	0	0	0	0	++	+	0	0	+
E. H.	12	M	+++	++	++	+	+++	+++	0	+++	+++
M. B.	12	F	+	+	0	0	+	+	0	+	+
G. P.	14	F	+	0	+	0	++	+++	0	++	+
B. S.	18	F	+	0	++	0	++	++	0	+++	+++
D. A.	24	F	0	0	++	0	+++	++	0	+	+
A. B.	49	F	+	0	+	+	+	+	0	0	+

at autopsy and because the physiological effect of right-to-left shunting through a septal defect and true anatomic overriding is the same (12). In ventricular septal defect with pulmonary hypertension, there is most likely a gradual change of direction of the shunt to actual reversal and development of the "Eisenmenger complex." The differential diagnosis between the anatomic and physiologic types is probably impossible roentgenographically.

The roentgenograms of the 20 patients were evaluated for cardiac size, presence of chamber enlargement, size of pulmonary arteries and veins, and size of the aorta. These were graded as normal (0), minimal (+), moderate (++), and marked (+++). The clinical charts were reviewed for catheterization data, electrocardiographic findings, and age and sex of the patients.

RESULTS

The ages of the patients ranged from six months to forty-nine years, with a median of eight years. Six of the patients

were males and 14 were females. This is at variance with other series, in which equal sex distribution has been the rule (1, 4, 5).

Sixteen (80 per cent) of the patients had pulmonary hypertension (systolic pressure of over 30 mm. Hg in the pulmonary artery) demonstrated by catheterization. It has been shown that the degree of pulmonary hypertension alone does not materially affect the severity of the roentgen changes in congenital heart disease, as is the case in mitral valvular disease (17). Therefore, the frequency of pulmonary hypertension in this series is not believed to prejudice the applicability of the data.

The roentgen findings in the individual patients are listed in Table I. The commonly accepted roentgen criteria of cardiac and chamber enlargement were utilized in this series.

Seventeen patients, or 85 per cent, showed hearts which were enlarged. The degree of enlargement varied widely. In 35 per cent of the series it was minimal, in 40 per cent moderate, and in 10 per cent marked. Enlargement of the right ventricle was most frequent, occurring in 85 per cent of the patients. Left ventricular enlargement was found in 65 per cent, representing a higher incidence than is usually appreciated. Combined ventricular enlargement was present in 60 per cent of the patients. An incidence of left atrial enlargement of 45 per cent confirms the frequency of this recently reported finding. There was considerable variation in the size of the enlarged left atria (Figs. 1 and 2). The combination of enlargement of both ventricles and the left atrium was noted in 26 per cent of the patients.

With a single exception, the main pulmonary artery was enlarged, and all patients showed enlargement of the hilar vessels. Eighty-five per cent showed an associated increase in prominence of the peripheral pulmonary vascularity.

The appearance of the pulmonary veins in heart disease has been described recently, and their enlargement in left-to-right intracardiac shunts has been reported (18).

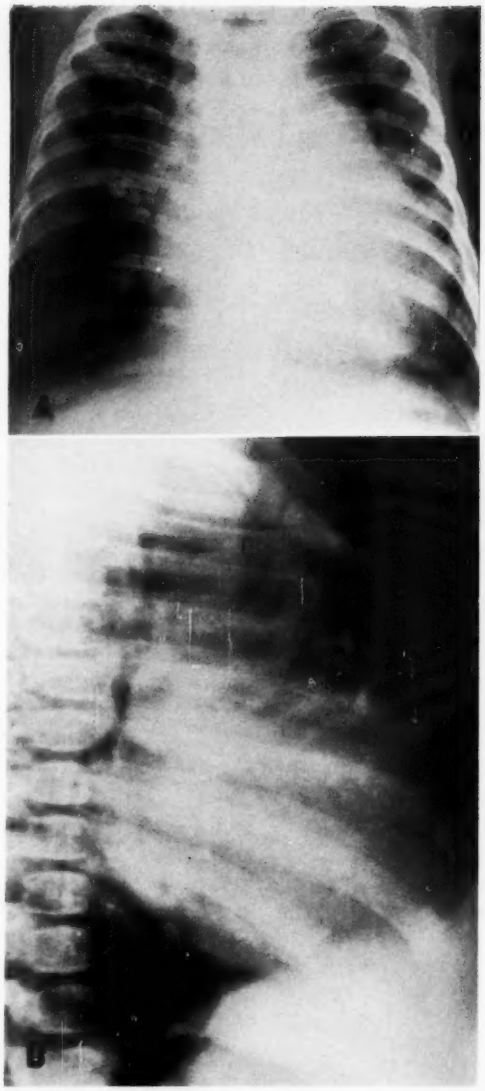

Figure 2. Postero-anterior and left lateral roentgenograms of the chest of a 6-month-old girl with ventricular septal defect, showing right ventricular and marked left atrial enlargement.

The incidence of 70 per cent enlargement in this series confirms the impression of the frequency of this association.

None of the patients showed an aorta which, roentgenographically, was believed to be larger than normal. This finding is of some importance in differential diagnosis and will be discussed later.

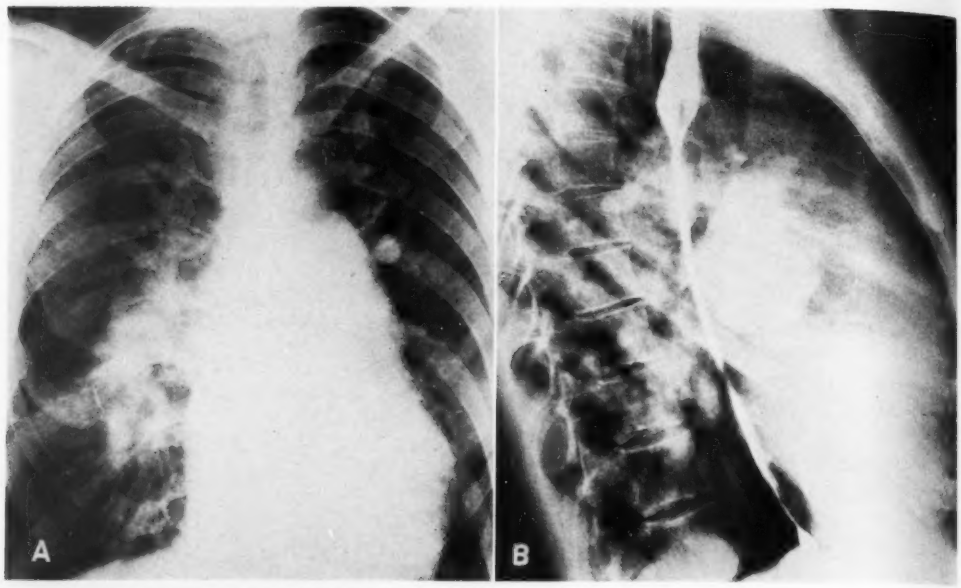

Figure 3. Postero-anterior, left lateral, and left anterior oblique roentgenograms of the chest of a 43-year-old woman with atrial septal defect, showing right ventricular enlargement and marked prominence of the pulmonary artery and of the pulmonary vascularity. Note absence of left ventricular and left atrial enlargement.

It was anticipated that there might be some correlation between the age of the patient and the severity of the roentgen signs, but no such relationship could be established, except for left atrial enlargement, which was found frequently in the younger patients. This may, however, be wholly or in part a matter of technic, since apparent left atrial enlargement as seen in the lateral projection may be produced by incomplete inspiration at the time of filming. The difficulty of obtaining roentgenograms during full inspiration in very young children is common knowledge.

All of the patients were studied by electrocardiography. The frequency of right ventricular hypertrophy (50 per cent) is in agreement with the high incidence of right ventricular enlargement noted roentgenographically. Left ventricular hypertrophy (25 per cent) and right bundle branch block (30 per cent) were frequently found. The combinations of right ventricular hypertrophy with right bundle branch block, and of right ventricular with left ventricular hypertrophy, were each observed in 10 per cent of the cases. The combination of left ventricular hypertrophy with right bundle branch block was found in 5 per cent. These electrocardiographic findings are in accordance with those re-

ported by other workers (1, 11), though somewhat at variance with the observations of Kjellberg *et al.* (4), who claim that right bundle branch block is not often found in ventricular septal defect.

COMMENTS

The observations recorded indicate that isolated ventricular defects may present a wide variety of roentgen and electrocardiographic signs. Certainly the concept of the benignity of this lesion is no longer tenable.

From the data, it would appear that the most characteristic appearance of isolated ventricular septal defect is a slightly or moderately enlarged heart with right ventricular enlargement and associated enlargement of the left ventricle and/or the left atrium. The pulmonary artery is enlarged and there is increased prominence of the pulmonary vascularity in both its arterial and venous phases. The aorta is not increased in size. These signs may be of considerable practical importance in differential diagnosis.

The congenital anomalies which are confused most commonly with a ventricular septal defect are patent ductus arteriosus and atrial septal defect. In an attempt to clarify the problem of differential diagnosis between ventricular septal defect and atrial septal defect, the films of 11 patients with atrial septal defect (proved by catheterization) were reviewed for evidence of chamber enlargement, particularly on the left side of the heart. In only 1 instance was there any suggestion of left ventricular enlargement, and in 1 other of left atrial enlargement. Others also report the absence of left sided enlargement in atrial septal defect (9, 11). Left ventricular or left atrial enlargement, when present, is thus helpful in distinguishing ventricular septal defect from atrial septal defect (Fig. 3). It has been said that the heart is generally larger in atrial septal defect than in ventricular septal defect (19, 20), but in our experience and that of others (5, 22) this has not proved to be a valuable differential sign.

The appearance of the heart in patent ductus arteriosus may mimic that in ventricular septal defect when the patent ductus is associated with pulmonary hypertension resulting in right ventricular enlargement. A recent evaluation of the roentgen signs of patent ductus arteriosus (21) has shown the high incidence of left ventricular and left atrial enlargement in that condition (68 per cent and 67 per cent, respectively), as well as an incidence of right ventricular enlargement of 42 per cent. This would confirm what is well known, that it may be extremely difficult to differentiate patent ductus arteriosus from ventricular septal defect roentgenographically. A finding which may be of some differential importance is the increased size of the aorta which is sometimes seen in patent ductus arteriosus. Such enlargement has been shown in this study and in other reports to be rare in ventricular septal defect (4, 11). The usefulness of this sign is limited by its relatively infrequent occurrence in patent ductus arteriosus (11 per cent) (21).

CONCLUSIONS AND SUMMARY

An evaluation of roentgenographic and electrocardiographic manifestations in 20 cases of isolated ventricular septal defect proved by catheterization has been presented. This cardiac anomaly produces roentgen signs varying widely in magnitude, the degree apparently being dependent upon the size of the septal defect. Analysis of the data indicates that the most characteristic roentgen appearance of isolated ventricular septal defect is a slightly or moderately enlarged heart with right ventricular enlargement and enlargement of the left ventricle and/or the left atrium. The pulmonary artery and its branches are increased in size, and there is commonly enlargement of the pulmonary veins as well.

Ventricular septal defect may be differentiated roentgenographically from atrial septal defect by the absence of left-sided cardiac enlargement in the latter condition, and from those cases of patent ductus arteriosus in which the aorta is enlarged.

Such enlargement is rare in ventricular septal defect.

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SUMMARIO IN INTERLINGUA

Evalutation del Manifestationes Roentgenologic de Defectos Isolate del Septo Ventricular

Es presentate un evalutation del manifestationes roentgenographic e electrocardiographic in 20 casos de isolate defectos del septo ventricular, demonstrate per medio del technica de catheterisation. Iste anormalitate cardiac produce signos roentgenologic que varia grandemente in lor magnitude, apparentemente in dependentia del dimensiones del defecto septal. Le analyse del datos indica que le plus characteristic apparentia roentgenologic de isolate defectos del septo ventricular es un leve- o moderatemente allargate corde con allargamento dextero-ventricular e allargamento del ventriculo sinistre e/o del atrio sinistre. Le arteria pulmonar e su brancas es allargate, e generalmente il ha etiam un allergamento del venas pulmonar.

Defectos del septo ventricular pote esser differentiate roentgenographicamente ab defectos del septo atrial per le facto que allargamento cardiac al latere sinistre es absente in defectos del septo atrial. Defectos del septo ventricular pote esser differentiate roentgenographicamente ab ille casos de patente ducto arteriose in que le aorta es allargate. Iste allargamento es rar in casos de defecto del septo ventricular.

Radiographic Estimation of Pulmonary Artery Pressure in Mitral Valvular Disease[1]

GEORGE JACOBSON, M.D., LEONARD H. SCHWARTZ, M.D., and MARCY L. SUSSMAN, M.D.

IT IS BECOMING increasingly evident that the surgical relief of mitral stenosis should not be attempted unless associated pulmonary hypertension can be demonstrated (3, 4, 7, 10). In the absence of pulmonary hypertension, symptoms of cardiac failure are usually due to active rheumatic carditis or myocardial insufficiency, and in these cases mitral commissurotomy may be expected to produce a poor result or even lead to the death of the patient.

The clinical diagnosis of pulmonary hypertension is difficult inasmuch as it produces no completely reliable physical or electrocardiographic findings. Its radiographic determination, however, offers considerable promise, since it has been shown that the appearance of the pulmonary vessels is a reflection of pulmonary hemodynamics (1, 5, 11, 13, 15, 18, 19). The present study was undertaken to determine whether a clinically useful correlation could be established between the size of the pulmonary artery and its major branches and the pulmonary artery pressure. Since the main purpose of cardiac catheterization in many cases of mitral valvular disease is the determination of pulmonary pressure, it might be possible, by means of such a correlation, to avoid catheterization in some cases.

PULMONARY HYPERTENSION IN MITRAL STENOSIS

In the normal man, pulmonary artery pressure remains fairly constant under most physiologic conditions. For example, though the cardiac output increases with exercise, the pressure remains within normal limits or may even show a slight drop because of the marked distensibility of the vascular bed. It has been shown that this holds true until the pulmonary flow is approximately three times the normal (4, 9).

Cardiac output is also increased by anoxia, although under this circumstance there is a rise in pulmonary artery pressure roughly proportional to the degree of oxygen deficiency. Cournand (4) has pointed out that in the normal subject this increase in cardiac output with anoxia is never sufficient in itself to explain pulmonary hypertension. In all likelihood, the hypertension is the result of a substantial reduction in the total vascular bed due to local vasoconstriction of pulmonary arteries and arterioles. Chronic anoxia also leads to polycythemia and hypervolemia, and these, in the presence of a restricted vascular bed, further increase the hypertension. Such a system is sensitive even to small increments in blood flow. This type of hypertension is reversible. The pressure returns to normal permanently with the relief of the anoxia or temporarily following the administration of vasodilator drugs.

Pulmonary hypertension may also result from any anatomic lesion which causes an increased resistance to pulmonary blood flow. This may be due to a reduction in the number, caliber, or elasticity of the small vascular channels, as in the various forms of diffuse pulmonary fibrosis, or of the larger arterioles and arteries by arteriosclerosis or even multiple emboli. Increased resistance to blood flow may be caused also by obstruction beyond the lung, as in mitral stenosis or left ventricular failure.

The present concept of the pathogenesis of pulmonary hypertension in mitral ste-

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nosis is based largely on the work of Parker and Weiss (14), who showed in 1936 that, in addition to the mechanical effect of the mitral stenosis, permanent structural changes occur in both the lungs and vessels. They demonstrated, among other findings, dilatation of capillaries, increase in interstitial tissue, and increase in thickness of the capillary basement membrane of the aveoli to a degree which they believed would interfere with gaseous exchange. In addition, they described intimal thickening, hyperplastic sclerosis, and necrosis of the pulmonary arterioles. Their findings were substantiated in 1949 by Larrabee, Parker, and Edwards (12) who showed that medial hypertrophy could occur with or without accompanying intimal fibrosis or medial scarring. These latter workers expressed the belief that medial hypertrophy was a reversible lesion.

Subsequent studies (1–3, 5–8, 10) correlating the pulmonary hemodynamics in mitral stenosis with the pathologic changes seen in the lungs have amply confirmed these findings and have led to conclusions which may be summarized as follows: Pulmonary hypertension cannot be related entirely to the degree of mechanical obstruction of the valve, since a few patients with mitral stenosis will have normal pulmonary artery pressures. The mechanical effect of mitral stenosis in most cases is to cause a rise in pulmonary venous and capillary pressure and mild pulmonary arterial hypertension. At first, anoxia and vasoconstriction may lead to active, more severe hypertension which, at this stage, is reversible. Permanent structural changes subsequently occur in the vessels, resulting in irreversible hypertension. Unfortunately these changes cannot be demonstrated radiologically. They should not be confused with hemosiderosis, which cannot be related to pulmonary hypertension. Since there are no reliable means, either clinical or radiologic, of differentiating between reversible and irreversible hypertension, mitral valve surgery should not be withheld because of the severity of the hypertension or the presence of radiologically visible pulmonary lesions.

MATERIAL

This study is based upon 124 patients in whom the diagnosis of rheumatic heart disease with mitral stenosis, or mitral stenosis and insufficiency, was made clinically. Each case was reviewed and the diagnosis affirmed at one of the weekly cardiac conferences at the Los Angeles County Hospital conducted either by Dr. George C. Griffith or Dr. William P. Thompson. A majority of the diagnoses were confirmed at surgery or at autopsy. All patients were subjected to cardiac catheterization and pressures were recorded by Statham pressure transducers and photo-oscillometric recorders. For the purpose of this study, only the maximum resting systolic pulmonary artery pressures were considered. Clinically, all patients were compensated at the time of catheterization.

Each patient was examined radiologically several days prior to catheterization, except in a few cases where the examination preceded catheterization by two or three weeks.

METHOD

The roentgenograms were read independently by two of the authors (M. L. S. and G. J.) without knowledge of catheterization findings. The individual readings were then compared with each other and the differences resolved. As the study proceeded and criteria for classification were established, it became more and more evident that the roentgenograms were being grouped by judgment and experience and that we were learning in the process. With this in mind, and with knowledge of the pulmonary artery pressures, the films were reinterpreted by two of us (G. J. and L. H. S.) and the differences between this and the original interpretations resolved. Only the final set of readings was used for this study.

The pulmonary artery and its major branches were examined as they appeared

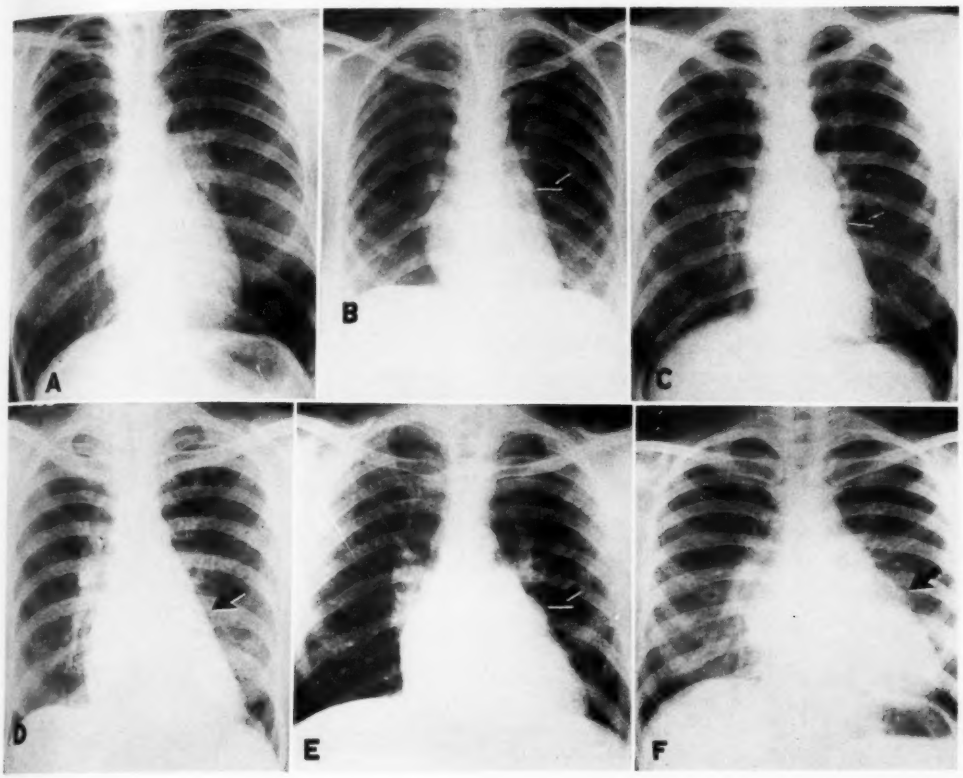

Fig. 1. Variations, pulmonary artery segment (PAS) Grade 1: Normal or slightly enlarged pulmonary artery segment with normal appearing major branches of the pulmonary artery. Arrows point to left auricular appendage. The following examples are from pulmonary artery pressure Group 1 (0–50 mm. Hg). A. Pulmonary artery pressure, 40 mm. Hg. B. Pulmonary artery pressure, 48 mm. Hg. C. Pulmonary artery pressure, 21 mm. Hg. D. Pulmonary artery pressure, 22 mm. Hg. E. Pulmonary artery pressure, 30 mm. Hg. F. Pulmonary artery pressure, 45 mm Hg.

in all four projections of the chest, *i.e.*, postero-anterior, left anterior oblique, right anterior oblique, and lateral. Ordinarily the left cardiac border, as seen in the frontal projection, displays three distinct curves. The upper curve is formed by the arch of the aorta and the lower by the left ventricle. The middle, or pulmonary artery segment, has been shown repeatedly by angiocardiography and cardiac catheterization to be formed by the main pulmonary artery, or occasionally by its left descending branch. The appearance of this segment, as was pointed out in a previous discussion (16), varies considerably in normal individuals and depends to a large degree on the conformation of the chest as well as the anatomical course and diameter of the artery. In mitral stenosis, a fourth curve is frequently seen, located between the pulmonary artery segment above and the left ventricle below. This is produced by enlargement of the left auricular appendage and must be carefully distinguished from the pulmonary artery segment, with which it may easily be confused.

In the right oblique projection, the pulmonary artery forms a variable portion of the anterosuperior border of the heart but is not recognized as a distinct structure. It is even more difficult to distinguish the pulmonary artery in the left oblique and lateral projections, where it

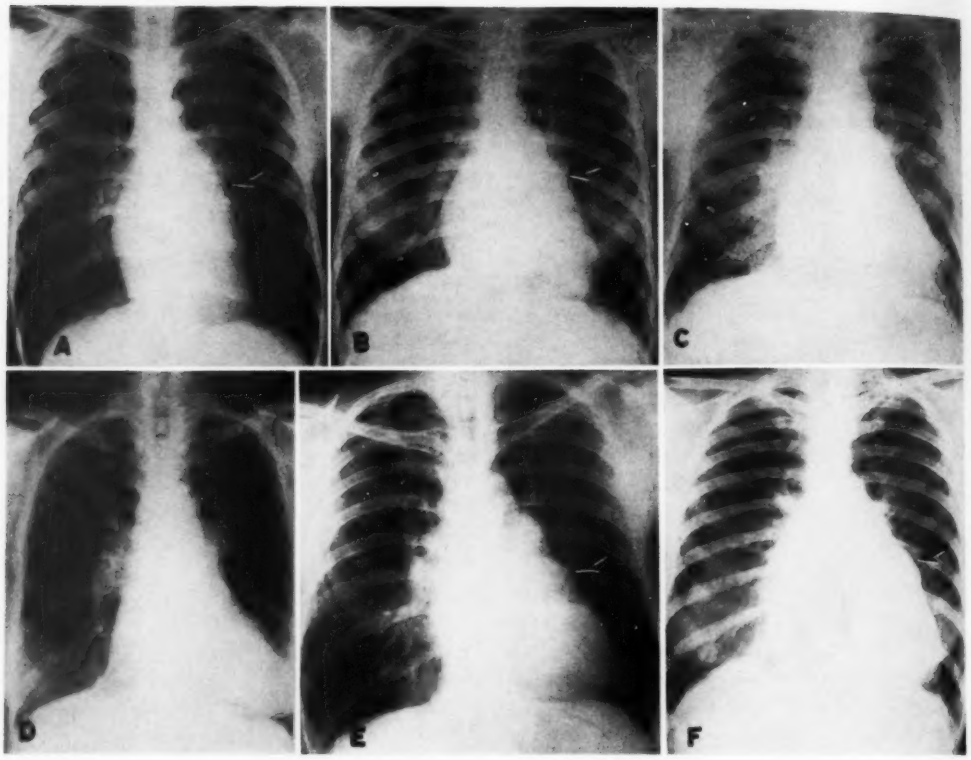

Fig. 2. Variations, PAS Grade 2: Moderate enlargement of the pulmonary artery segment and/or slight to moderate enlargement of the major branches of the pulmonary artery. Arrows point to left auricular appendage. The following examples are from pulmonary artery pressure Group II (51–90 mm. Hg). A. Pulmonary artery pressure, 55 mm. Hg. B. Pulmonary artery pressure, 90 mm. Hg. C. Pulmonary artery pressure, 68 mm. Hg. D. Pulmonary artery pressure, 60 mm. Hg. E. Pulmonary artery pressure, 78 mm. Hg. F. Pulmonary artery pressure, 57 mm. Hg.

becomes superimposed upon and blends with the shadow of the ascending aorta. Since the main pulmonary artery is never visualized in its entirety by conventional radiography, its exact size can be determined only by angiocardiography. However, the degree of prominence of the pulmonary artery segment, in general, does reflect the size of the artery itself.

After comparison of the original radiographic interpretations, it was apparent that we could not evaluate the size of the pulmonary artery segment with any degree of accuracy on either of the oblique or lateral views. The size of the segment in the postero-anterior view was classified as Grade 1, 2, or 3. Grade 1 (Fig. 1) represented a normal or slightly enlarged pulmonary artery segment with major pulmonary artery branches of normal appearance. Grade 2 (Fig. 2) comprised cases of moderate enlargement of the pulmonary artery segment and/or slight to moderate enlargement of the major branches of the pulmonary artery. Some cases with minimal pulmonary artery segment enlargement, but with moderate pulmonary artery branch enlargement, were included in this group. Grade 3 (Fig. 3) consisted of cases with marked pulmonary artery segment enlargement and/or moderate to marked increase in the size of the major branches of the pulmonary artery.

For the purpose of brevity, reference to the pulmonary artery segment will be

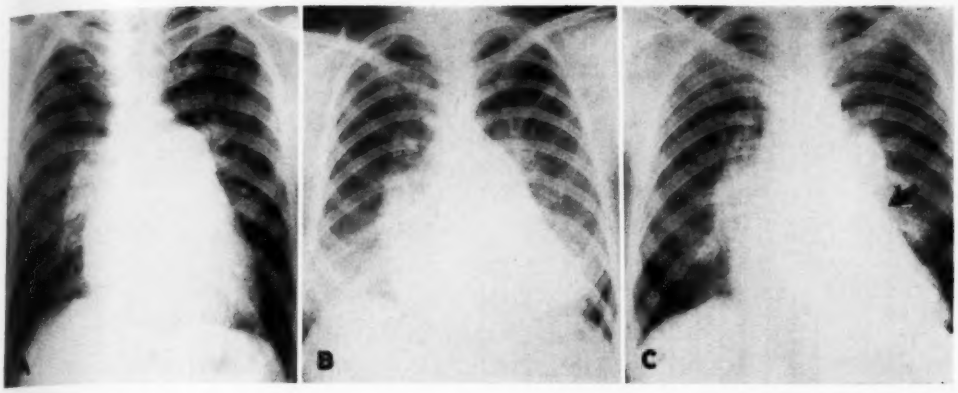

Fig. 3. Variations, PAS Grade 3: Marked enlargement of pulmonary artery segment and/or moderate to marked enlargement of the major branches of the pulmonary artery. Arrows point to left auricular appendage. Examples from pulmonary artery pressure Group III (above 90 mm. Hg.) A. Pulmonary artery pressure, 200 mm. Hg. B. Pulmonary artery pressure, 100 mm. Hg. C. Pulmonary artery pressure, 120 mm. Hg.

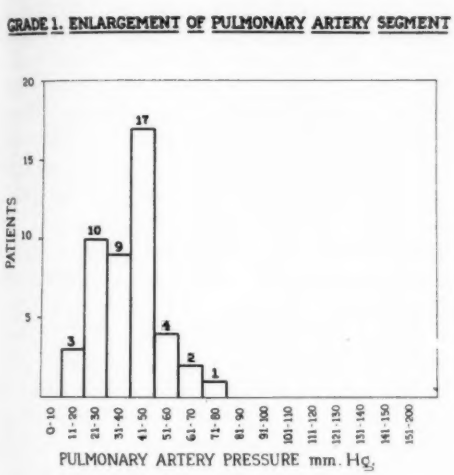

Fig. 4. Distribution of pulmonary artery pressures in Grade 1 enlargement of the pulmonary artery segment.

taken to include the major branches of the pulmonary artery and will be abbreviated as PAS.

Our cases were divided into three pressure groups which gave the best correlation with the grade of PAS enlargement rather than according to severity of hypertension. For example, it soon became apparent that mild pulmonary hypertension, 40 to 50 mm. Hg, ordinarily produced no appreciable changes in the PAS, or only slight enlargement that was not readily distinguishable from the normal. All cases, therefore, with normal pressure or hypertension up to 50 mm. Hg were placed in Group I. Ordinarily, pulmonary hypertension is regarded as severe when the systolic pressure is greater than 70 mm. Hg. However, rather than use this pressure as the dividing point between Groups II and III, we found that a better correlation was obtained by the inclusion of pressures from 51 to 90 mm. Hg in Group II, and pressures above 90 mm. Hg in Group III.

RESULTS

On the basis of pulmonary artery enlargement, the cases were graded as follows:

Grade	*Cases*
1	46 (37 per cent)
2	57 (46 per cent)
3	21 (17 per cent)

The grouping according to pulmonary artery pressure were:

Group	*Cases*
I (0–50 mm. Hg)	51 (41 per cent)
II (51–90 mm. Hg)	49 (40 per cent)
III (above 90 mm. Hg)	24 (19 per cent)

These results are presented graphically in Figures 4–8.

DISCUSSION

A number of authors (1, 17, 19) have commented on enlargement of the pulmo-

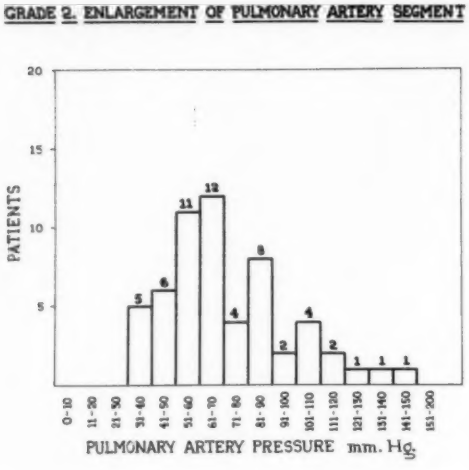

Fig. 5. Distribution of pulmonary artery pressures in Grade 2 enlargement of the pulmonary artery segment.

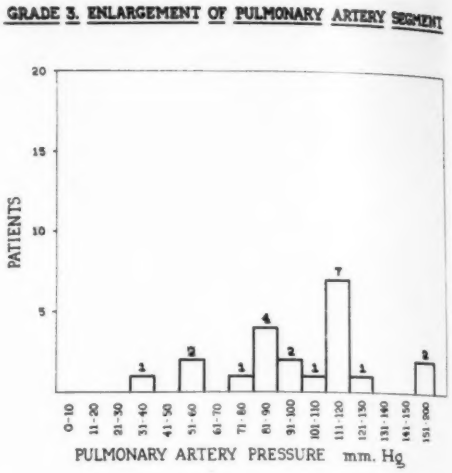

Fig. 6. Distribution of pulmonary artery pressures in Grade 3 enlargement of the pulmonary artery segment.

nary artery in response to pulmonary hypertension. Healey, Dow, Sosman, and Dexter (11) concluded that an abnormal increase in pressure in the pulmonary artery at rest resulted in changes indistinguishable from those of increased flow. Theoretically at least, if there is no increase in flow, it should be possible to estimate pulmonary artery pressure from the size of the main pulmonary artery and its major branches. This is borne out by the studies of Davies, Goodwin, Steiner, and Van Leuven, who in 1953 (5) reported their experience in assessing pulmonary hypertension in mitral stenosis. Their series was composed of 51 patients, 22 of whom were studied by venous angiocardiography and 9 by pulmonary artery arteriography. Enlargement of the main arteries associated with narrowing, tortuosity, and irregularity of the peripheral branches, mainly at the bases, was found to be present in those patients with pulmonary hypertension. These findings were more widespread when the hypertension was severe. The angiocardiograms were compared with the plain radiographs and most of the changes proved to be present in both. It was thought that the correlation was good enough to permit the severity of the arterial changes to be graded by examination of the plain films. In the opinion of these authors, these changes were a better guide to the pulmonary arterial pressure than were the symptoms and clinical signs. In 1954, Steiner and Goodwin (15) stated: "In our experience, the size of the main pulmonary artery correlates well with the degree of pulmonary hypertension when this is moderate or severe. In patients with normal or moderately elevated pulmonary arterial pressures, the degree of enlargement of the main pulmonary artery varies considerably, whereas in those with evidence of severe pulmonary hypertension there is always marked enlargement."

Evaluation of the size of the pulmonary artery segment presented considerable difficulty. After some experience, however, it was found possible to divide our cases into three groups based on the appearance of the pulmonary artery segment and main branches of the pulmonary artery as seen in the frontal projection: Grade I, normal or slightly enlarged PAS; Grade II, moderately enlarged PAS; Grade III, markedly enlarged PAS. As previously noted, the cases were divided arbitrarily into three pressure groups: Group I, 0–50 mm. Hg; Group II, 51–90 mm. Hg; Group III, 91 mm. Hg and above.

The best correlation of PAS size with pressure grouping was obtained in Grade 1 enlargement, where 85 per cent were in pressure Group I (Fig. 7). In both Grade 2 and Grade 3 enlargement, 62 per cent of the cases were in the corresponding pressure groups. Conversely (Fig. 8), 76 per

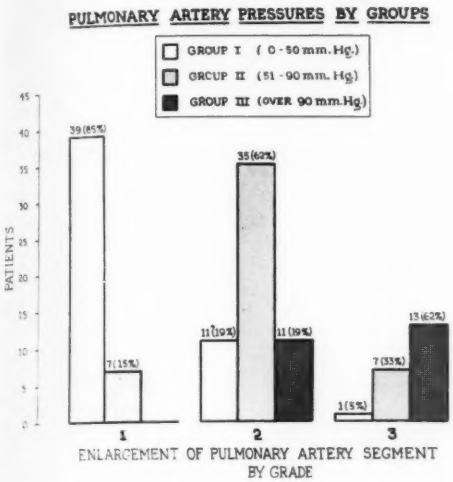

Fig. 7. Distribution of pulmonary artery pressure by groups in each grade of pulmonary artery segment enlargement.

cent of those in pressure Group I were of PAS Grade 1; 72 per cent of those in pressure Group II were of PAS Grade 2; only 54 per cent of pressure Group III were of PAS Grade 3.

Our results suggest that the larger the pulmonary artery segment or the higher the pulmonary artery pressure, the poorer the correlation between the two. It should be noted, however (Fig. 7), that no patient with a Grade 1 pulmonary artery segment enlargement had a Group III pressure, and only one PAS Grade 3 enlargement fell in pressure Group I. It is of interest that those cases of PAS Grade 2 which were not in pressure Group II were distributed equally in pressure Groups I and III. In pressure Group II, there was a similar distribution of cases which were not of PAS Grade 2.

In all, there were 37 cases (30 per cent) in which the pulmonary artery segment

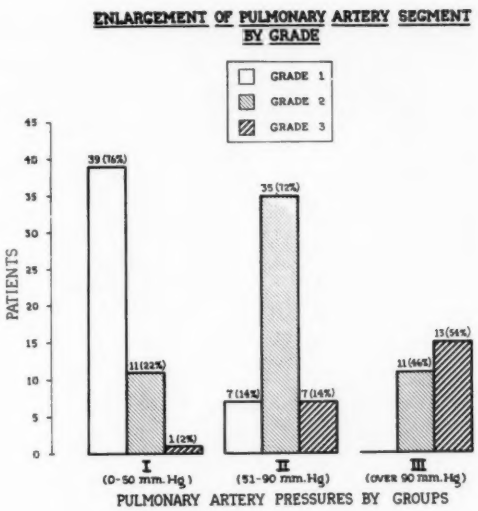

Fig. 8. Distribution of pulmonary artery segment enlargement by grade in each pulmonary artery pressure group.

classification did not correspond to the pressure grouping. A significant number of these errors were undoubtedly due to the fact that each case was placed in a pressure group on the basis of a single observation, which reflected the pulmonary artery pressure during catheterization only, and not necessarily under other conditions. The groupings were of necessity arbitrary, and varying degrees of correlation could be established by slight changes in the end points of the groups. In a number of instances this would have required a change of only 1 mm. Hg of pressure.

The cases most difficult to classify were those in which the pulmonary artery segment was largely, or in part, obscured by enlargement of the left auricular appendage or left atrium. While an accurate tabulation of the errors attributable to this factor is not possible, it was important in many instances. In Fig. 9A the pulmonary artery segment was classified as showing Grade 1 enlargement while the pulmonary artery pressure was 80 mm. Hg, Group II. The projecting left auricular appendage partially hides the pulmonary artery, which is probably larger than it appears. In Fig. 9B, which was classified

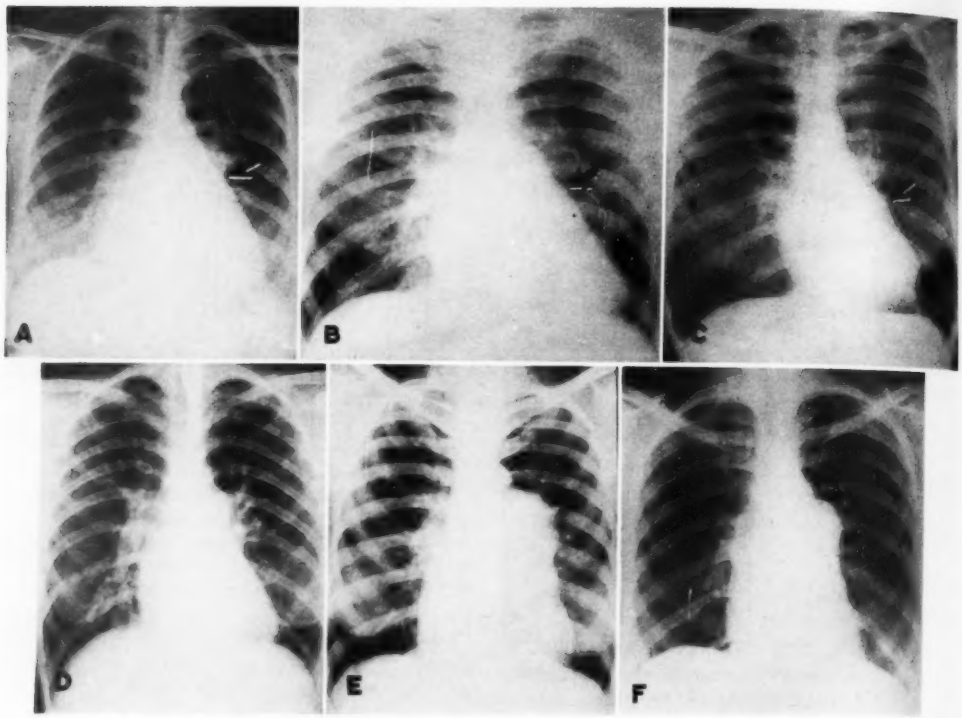

Fig. 9. Errors in classification of pulmonary arterial segment.

A. PAS Grade 1. Pulmonary artery pressure, Group II, 80 mm. Hg. The left auricular appendage (arrow) partially obscures the pulmonary artery segment, which is probably larger than it appears.

B. PAS Grade 2. Pulmonary artery pressure, Group I, 38 mm. Hg. The left auricular appendage (arrow) adds to the pulmonary artery segment, making it appear larger than it probably is.

C. PAS Grade 1. Pulmonary artery pressure, Group II, 65 mm. Hg. Normal pulmonary artery segment with moderate pulmonary hypertension.

D. PAS Grade 2. Pulmonary artery pressure, Group III, 129 mm Hg. Moderately enlarged pulmonary artery segment and normal peripheral pulmonary vessels with severe pulmonary hypertension.

E. PAS Grade 3. Pulmonary artery pressure, Group II, 78 mm. Hg. Extreme enlargement of pulmonary segment and normal peripheral vessels with moderate hypertension. Pulmonary diastolic pressure elevated; pressure may have been higher with compensation.

F. PAS Grade 3. Pulmonary artery pressure, Group I, 35 mm. Hg. Marked enlargement of pulmonary artery segment and normal peripheral vessels in absence of pulmonary hypertension may represent aneurysmal or idiopathic dilatation of the pulmonary artery.

as PAS Grade 2 while the pressure was 38 mm. Hg, or Group I, the left atrium and auricular appendage add to the shadow of the pulmonary artery segment.

In the remaining errors, the size of the pulmonary artery segment did not accurately reflect the pulmonary artery pressure. The pressure in Fig. 9C was 65 mm. Hg, Group II, while the pulmonary artery segment is entirely normal, Grade I. Fig. 9D is an example of moderately enlarged pulmonary artery segment with normal peripheral vessels, Grade 2, in which the pressure was markedly elevated, 129 mm. Hg, Group III. In the largest pulmonary artery segment encountered in the entire series, Fig. 9E, the pressure was 78 mm. Hg, Group II. In this case, the pulmonary diastolic pressure was also elevated, indicating cardiac failure. It is likely that, in the presence of compensation, the systolic pressure had been higher. The pulmonary artery segment in Fig. 9F is markedly enlarged, Grade 3, while the pulmonary artery pressure was only 35 mm. Hg, Group I. Although the diag-

nosis of mitral stenosis was confirmed at surgery, this probably represents either aneurysmal or so-called idiopathic dilatation of the pulmonary artery.

The question arises: if we accept the thesis that only those patients with mitral stenosis who have pulmonary hypertension should undergo mitral commissurotomy, what would have been the effect of relying on the appearance of the pulmonary artery segment as an indication of pulmonary pressure? For this purpose, we may assume that a systolic pulmonary artery pressure above 40 mm. Hg represents significant hypertension. In Grade 3 enlargement of the pulmonary artery segment (Fig. 6), 20 of the 21 patients had hypertension. Thus, on the basis of pressure alone, only 1 patient would have unnecessarily undergone commissurotomy. Similarly (Fig. 5), 52 of the 57 patients with Grade 2 enlargement had hypertension. In other words, if the pulmonary artery pressure had been the only criterion for surgery, 72 of 78 patients (92 per cent) with moderate or marked enlargement of the pulmonary artery segment would properly have undergone a mitral commissurotomy. On the other hand (Fig. 4), in Grade 1 enlargement of the pulmonary artery segment, where the best correlation with pulmonary artery pressure groups was obtained (85 per cent), 24 out of 51 patients (47 per cent) had pulmonary hypertension and would have been denied surgery.

Further, if circumstances are such that the sole purpose of cardiac catheterization is to determine pulmonary artery pressure, it is probably unnecessary to perform this procedure when enlargement of the pulmonary artery segment is moderate or marked, since almost all of these patients will have significant pulmonary hypertension. This is not the case, however, when the pulmonary artery segment is normal or only slightly enlarged, since pulmonary hypertension may or may not be present. In this group, cardiac catheterization still remains an important procedure.

SUMMARY

1. A group of 124 patients with mitral valvular disease was studied to determine whether a clinically useful correlation could be established between the size of the pulmonary artery and its major branches (PAS) and the pulmonary artery pressure.

2. The pulmonary artery segment was classified on the basis of its appearance in the postero-anterior roentgenogram of the chest: Grade 1, normal or slightly enlarged; Grade 2, moderately enlarged; Grade 3, markedly enlarged.

3. The pulmonary artery pressures were divided into three groups: Group I, 0–50 mm. Hg; Group II, 51–90 mm. Hg; Group III, above 90 mm. Hg.

4. The best correlation between the size of the pulmonary artery segment and pulmonary artery pressure was obtained in PAS Grade 1, where 85 per cent of the cases were in pressure Group I.

5. The larger the pulmonary artery segment or the higher the pulmonary artery pressure, the poorer was the correlation between the two.

6. Of the total number of patients with PAS Grade 2 and Grade 3, 92 per cent had pulmonary hypertension. In PAS Grade 1, 47 per cent had significant hypertension (maximum systolic pressure above 40 mm. Hg).

7. If the sole purpose of cardiac catheterization is to determine pulmonary artery pressure, it is probably an unnecessary procedure when enlargement of the pulmonary artery segment is moderate or marked. When the pulmonary artery segment is normal, however, or just slightly enlarged, pulmonary hypertension can be excluded only by cardiac catheterization.

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SUMMARIO IN INTERLINGUA

Estimation Radiographic del Pression Pulmono-Arterial in Morbo del Valvula Mitral

Un gruppo de 124 patients con morbo del valvula mitral esseva studiate pro determinar si un correlation de utilitate clinic poteva esser establite inter (1) le dimensiones del arteria pulmonar e de su brancas principal (DAP) e (2) le pression pulmono-arterial. Le segmentos pulmono-arterial esseva classificate super le base de lor apparentia in le roentgenogramma postero-anterior del thorace. Esseva distinguite DAP Grado 1—normal o levemente allargate; DAP Grado 2—moderatemente allargate; e DAP Grado 3—marcatemente allargate. Etiam le pressiones pulmono-arterial esseva dividite in tres gruppos. Istos esseva: Gruppo I—0 a 50 mm Hg; Gruppo II—51 a 90 mm Hg; e Gruppo III—supra 90 mm Hg.

Le melior correlation inter le dimensiones del segmento pulmono-arterial esseva obtenite in DAP Grado 1. Octanta-cinque pro cento del casos de iste grado monstrava pressiones de Gruppo I. Quanto plus grande le segmento pulmono-arterial o quanto plus grande le pression pulmono-arterial, tanto minus bon le correlation inter le duo. Ex le total de patientes con DAP Grado 2 e Grado 3, 92 pro cento habeva hypertension pulmonar. Inter le patientes con DAP Grado 1, 47 pro cento habeva hypertension significative (maximo de pression systolic supra 40 mm Hg).

Nos conclude que catheterisation cardiac es probabilemente innecessari quando su sol objectivo es determinar le pression pulmono-arterial e quando le allargamento del arteria pulmonar es moderate o marcate. Alteremente, le exclusion de hypertension pulmonar es possibile solmente per medio de catheterisation cardiac.

Pleuropulmonary Tularemia: Its Roentgen Manifestations[1]

JOHN M. DENNIS, M.D., and ROBERT P. BOUDREAU, M.D.

PULMONARY involvement in tularemia is a pathologic entity which has been found to occur more commonly than was formerly believed and to have a high morbidity and mortality unless specific therapy is instituted early. Prompt diagnosis is therefore of the utmost importance, but is often difficult. Although the roentgen findings of tularemic pneumonia are not specific, they may suggest the diagnosis before the serum agglutinations become clinically significant or before the causative organism can be isolated.

Tularemia is produced by the organism, *P. tularensis*, and is usually transmitted to man by the handling of infected wild rabbits and rodents, ingestion of the meat of infected wild rabbits, and the bites of infected ticks. The diagnosis is usually confirmed by isolation of the organism or the rising serum agglutinin titres against *P. tularensis*. This serum agglutinin reaction is the most specific of all the serum agglutination tests and is clinically significant at titres of 1:160.

There are three main clinical forms of tularemia: (*a*) ulceroglandular, (*b*) oculoglandular, and (*c*) typhoidal. In each of these, pneumonia may occur, secondary to a bacteremia. A primary pulmonic form of the disease is also seen, but is rare. It is usually the result of inhalation of the organisms by laboratory workers.

Verbrycke (1) was the first to report pulmonary involvement as a pathologic observation in a case of tularemia in 1924. Numerous descriptions of the pathologic pulmonary findings followed shortly thereafter, but Simpson (2), in 1928, was the first to implicate involvement of the lungs as an integral part of the disease process rather than a terminal complication. Other investigators have dealt adequately with the clinical aspects of tularemic pneumonia (3–7). Sante (9) first described the roentgen findings in 1931, and many subsequent observers have added appreciably to our knowledge of this aspect of the disease (3, 5, 8, 11, 12).

As pointed out above, pneumonia occurs in association with tularemia more commonly than is generally believed, the reported incidence reaching as high as 32 per cent (3, 5, 8, 11–14). Pulmonary involvement is encountered with much greater frequency in the typhoidal form of the disease, from 50 to 77 per cent, as compared with 8 to 26 per cent in the non-typhoidal forms (3, 5, 6, 8, 11, 12).

In a review of 268 cases of tularemia, Stuart and Pullen (3) found a 73 per cent incidence of pneumonia in 95 cases coming to autopsy. A pleural reaction was associated with the pneumonia in approximately 50 per cent of the cases. The most frequently encountered pathologic lesion was a lobular or confluent lobular pneumonia involving one or several lobes. Microscopically, the pulmonary involvement has been described as a granulomatous lesion with a tendency to necrosis and cavitation (5, 7, 15). The similarity between the caseous pneumonias of tularemia and tuberculosis has been pointed out (16).

Before the introduction of specific antibiotic therapy with such drugs as streptomycin, Aureomycin, and chloramphenicol, the mortality rate in tularemia was 30 to 35 per cent, with pulmonary involvement in approximately two-thirds of the fatal cases (5). The figure is now extremely low, too few cases being reported to be of statistical value. Since a greater percentage of the pneumonias occur in typhoidal tularemia, with no evidence of a primary ulcerative lesion or demonstrable

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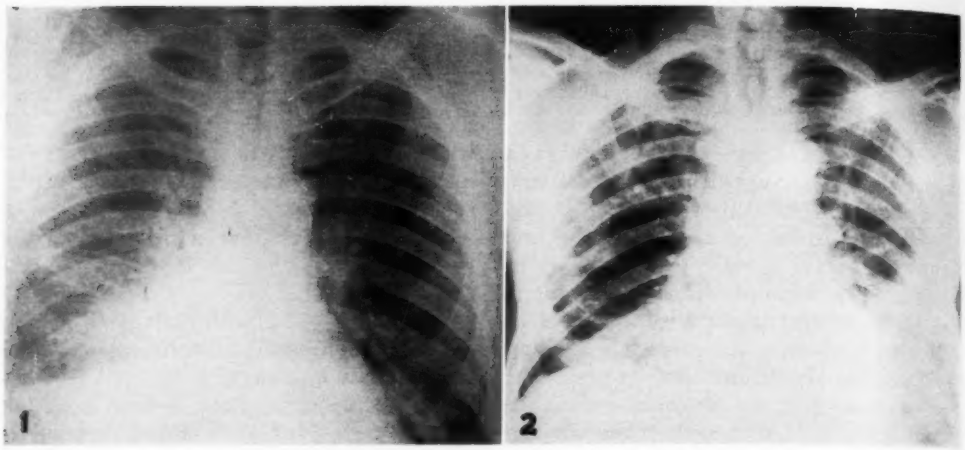

Fig. 1. L. F., a 40-year-old colored male, experienced fever, generalized malaise, and severe headache five days after dressing several wild rabbits, two of which he had eaten. The chest roentgenogram revealed a peribronchial and lobular homogeneous infiltration, with hilar adenopathy and pleural effusion evident on the right. Serum agglutinins against *P. tularensis* developed twelve days after inoculation and became positive at dilutions of 1:20, 480. *Diagnosis:* Tularemia, typhoidal form.

Fig. 2. J. I., a 53-year-old colored male, gave a history of malaise, cough, fever, delirium, and a tender mass in the right axilla, six days after dressing a wild rabbit. The chest roentgenogram revealed a diffuse lobular infiltration which was, in some areas, spherical in configuration. Serum agglutinins against *P. tularensis* became positive in titres of 1:640. *Diagnosis:* Ulceroglandular tularemia.

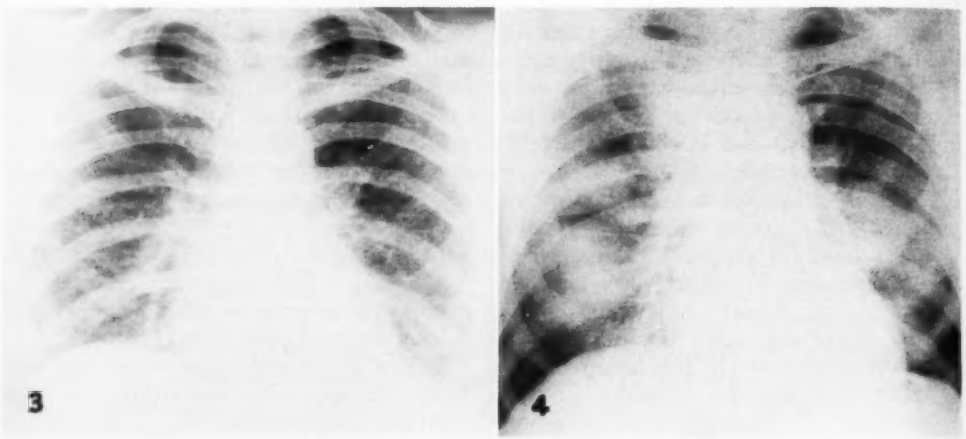

Fig. 3. V. G., a 29-year-old colored female, had a painful mass on the left forearm, an ulcer on the left thumb, headaches, malaise, fever, chills, anorexia, and weakness, two days after dressing a wild rabbit. The chest roentgenogram on admission revealed a fine diffuse peribronchial infiltration in both lungs. The clinical response to Achromycin was prompt, and the pulmonary infiltration resolved in six days. Serum agglutinins against *P. tularensis* developed after one month and were present in titres of 1:640. *Diagnosis:* Ulceroglandular tularemia.

Fig. 4. R. J., a 48-year-old colored male, experienced fever and malaise following a tick bite. The chest roentgenogram revealed bilateral spherical areas of infiltration and minimal interlobar pleural thickening on the right. Serum agglutinins against *P. tularensis* were present. *Diagnosis:* Tularemia, typhoidal form.

lymphadenopathy, early diagnosis may be difficult unless the serum agglutinins against *P. tularensis* are elevated or the disease is suggested by the history and roentgen findings. The present review is concerned primarily with the roentgenologic aspects.

MATERIAL

Between 1947 and 1955, 28 cases of tularemia were successfully treated at the

University of Maryland Hospital. The sources of infection were the same as those reported previously, *i.e.*, contact with infected rabbits and ticks and the ingestion of infected rabbit meat. Two cases also occurred in laboratory assistants in the Division of Infectious Diseases. The diagnosis in all instances was based upon the presence of serum agglutinins against *P. tularensis* or isolation of the organism.

ROENTGEN FINDINGS

Pleuropulmonary involvement was demonstrable roentgenologically in 14 of the 28 cases, or 50 per cent. It occurred in 7 of 10 patients with the typhoidal form of the disease (70 per cent) and in 5 of 15 patients (33 per cent) with the ulceroglandular form. Two cases were primary in the lung. Except for the 50 per cent overall incidence of pleuropulmonary involvement, which is greater than has been previously recorded, the statistics of this series are comparable with those of others (5, 6, 8).

Roentgenologically, the pulmonary involvement varied from a stringy peribronchial infiltration to one of homogeneous density with a lobular distribution. In a few cases both types were present, but the lobular homogeneous pattern was far more prevalent (Figs. 1–2). The infiltration varied greatly in location and extent. In 5 patients the process was bilateral, and in 3 it was diffusely scattered throughout both lungs. In 1 of this latter number, the infiltrative lesion was of the stringy peribronchial type, diffusely involving both lungs, resembling the first case described by Sante in 1931 (Fig. 3). In 3 other patients, the homogeneous infiltrate appeared as a spherical density, recently described by Ivie (12) as typical of tularemic pneumonia (Fig. 4). In only 1 instance was there suggestive evidence of cavitation, and this developed as the infiltrative lesion underwent resolution (Fig. 5). Hilar and mediastinal adenopathy was present in 3 cases (Fig. 1). Irrespective of the location or extent of the pulmonary involvement, there was almost always a tendency for its resolution to lag well behind the prompt clinical response to specific therapy (Fig. 6).

Fig. 5. G. W., a 39-year-old white male, experienced chills, fever, frontal headaches, and myalgia, six days after dressing wild rabbits. Chest roentgenogram revealed a peribronchial infiltration in the left lower lobe, where there was suggestive evidence of cavitation when the lesion began to resolve. *P. tularensis* was cultured from the sputum. *Diagnosis:* Tularemia, typhoidal form.

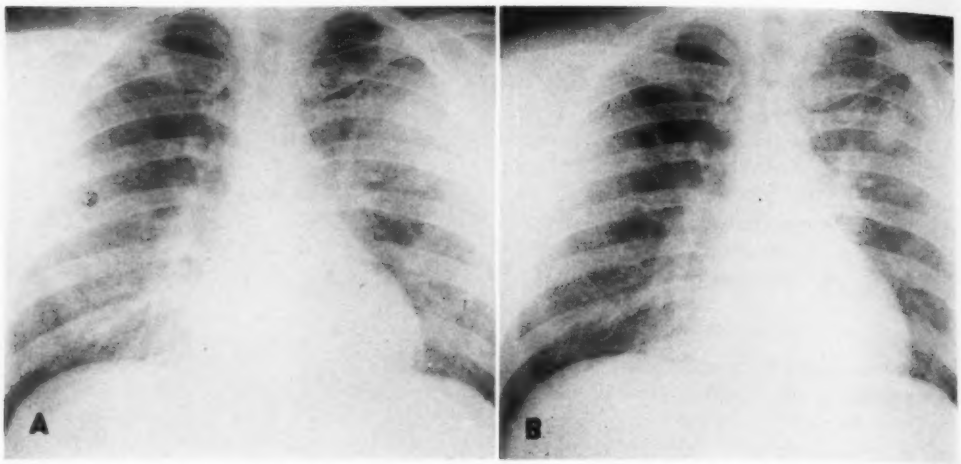

Fig. 6. L. L., a 27-year-old white male, a laboratory assistant, experienced headaches, fever, malaise, and photophobia, following exposure to *P. tularensis*. A chest roentgenogram made Aug. 30, 1949, revealed a lobular, homogeneous infiltration in the left upper lobe (A). Clinically, the patient responded rapidly to chloramphenicol, becoming asymptomatic within thirty-six hours, but there was a marked lag in resolution of the pulmonary lesion, as shown in a film obtained Sept. 9, 1949 (B). *Diagnosis:* Primary pulmonic tularemia.

Pleural involvement occurred in 9 of the 14 cases (64 per cent), varying from a slight thickening of an interlobar septum to extensive effusion (Figs. 4 and 7). While in most instances the pleural effusion was mild, it was always bilateral when parenchymal involvement was bilateral. Frequently fluid was not present at the time of the first roentgen study, becoming manifest only as the pulmonary process progressed.

DISCUSSION

Although the roentgenologic findings in tularemic pneumonia are not specific, some of them may suggest the correct diagnosis before the development of serum agglutinins against *P. tularensis*, which usually appear one to two weeks after inoculation. The significant findings in the present series were: (*a*) the frequent widespread and bilateral involvement; (*b*) the spherical configuration of the homogeneous infiltrate; (*c*) the frequency of pleural reaction and effusion; (*d*) the time required for resolution of pulmonary and pleural involvement following the clinical response.

The high incidence of pleural involvement in tularemia, as seen in our cases, has been well documented (3, 5, 8, 12, 17). That pleural reaction often does not occur early in the course of the disease was likewise substantiated, in the present series. The longer the condition persists untreated, the more frequent is pleural effusion; this may be the most significant finding in chronic cases (Fig. 7).

Ivie (12) has recently stressed the tendency of the pulmonary infiltration in tularemia to assume a spherical configuration. While we were not particularly impressed with the frequency of spherical lesions, we believe that their presence should suggest the diagnosis of tularemic pneumonia.

Bihss and Berland (11), in a review of 81 cases of tularemia, divided the roentgenologic manifestations of pleuropulmonary involvement into two basic types: (*a*) hilar lymphadenopathy, appearing in the earliest stages of the disease, with subsequent retrograde extension through the lymphatics into pulmonary parenchyma and pleura, with the production of effusion, seen more commonly in the ulceroglandular or oculoglandular forms; (*b*) primary involvement of the pulmonary parenchyma, with large homogeneous consolidations but no evidence of hilar lymphadenopathy, more common in the typhoidal form. In our series it was not possible to make this

distinction, and the 3 cases showing hilar lymphadenopathy were all of typhoidal type. While two types of infiltration were recognized—stringy peribronchial infiltration and homogeneous areas of consolidation—both were frequently encountered in the same case, and there was no correlation with the primary form of the disease. Peribronchial infiltration is believed to be the earliest roentgen manifestation of pulmonary involvement, since in some instances it has been seen to progress to a lobular homogeneous consolidation.

Prompt antibiotic therapy not only has decreased the morbidity and mortality rates in tularemic pneumonia but also has altered its roentgen aspects. Early investigators noted the resemblance of the more chronic forms to tuberculosis, with a tendency to necrosis and cavitation (10). In the present series not a single instance of resemblance to tuberculosis was encountered, and in only 1 case was there evidence of cavitation, which developed as the infiltrative lesion underwent resolution. Early diagnosis and specific therapy may also serve to abort almost completely the roentgenologic findings, as in Case III, in which the minimal diffuse peribronchial infiltration was resolved in six days (Fig. 3).

Fig. 7. C. S., a 61-year-old white female, had a slowly healing ulcer on her right index finger, with intermittent fever and malaise, after skinning a rabbit in November 1953. The fever and malaise persisted, and a chest roentgenogram on March 3, 1954, revealed an extensive pleural effusion on the left. Serum agglutinins against *P. tularensis* were present in dilutions of 1:320 on three occasions. *Diagnosis:* Chronic ulceroglandular tularemia.

SUMMARY

1. Pulmonary and pleural involvement in tularemia occurs more commonly than was originally believed.

2. Early diagnosis and specific therapy are important in reducing morbidity and mortality.

3. The roentgen manifestations of 14 cases of pleuropulmonary tularemia are discussed. While not specific, these findings may suggest the diagnosis early in the course of the disease.

4. Prompt diagnosis and the institution of specific therapy may serve to alter the roentgenologic aspects of tularemic pneumonia.

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SUMMARIO IN INTERLINGUA

Tularemia Pleuropulmonar: Su Manifestationes Roentgenologic

In un serie de 28 casos de tularemia, le autores trovava 14 con affectiones pleuropulmonar.

Radiologicamente le processo pulmonar variava inter un filamentose infiltration peribronchial e un homogenee densitate con distribution lobular. In un certe numero de casos, ambe typos de infiltration esseva presente, sed le typo a homogeneitate lobular esseva multo plus frequente. Le infiltrationes variava grandemente in loco e extension. In 5 patientes le affection esseva bilateral; in 3 le processo esseva diffusemente disseminate in omne partes de ambe pulmones. In 1 de iste 3, le lesion infiltrative esseva filamentose e peribronchial, con affection diffuse de ambe pulmones. In 3 altere patientes, le infiltrato homogenee se presentava como un densitate spheric, un forma que esseva recentemente describite como typic de pneumonia tularemic. Un sol caso exhibiva indicios de cavitation, e isto se disveloppava con resolution del lesion infiltrative. Adenopathia hilar e mediastinal esseva presente in 3 casos. Affectiones pleural esseva presente in 9 del 14 casos. Sin reguardo al loco e al extension del affection pulmonar, su resolution se distingueva per le quasi invariabile tendentia de retardar se marcatemente post le prompte responsa clinic a therapias specific.

Ben que le signos roentgenologic non es specific, illos pote suggerer le diagnose tosto in le curso del morbo. Assi illos pote inspirar le uso de un therapia specific e resultar in le consequente reduction de morbiditate e mortalitate.

Breve historias de septe casos accompania le illustrationes.

Nocardiosis

A Case Report and Brief Review of the Literature[1]

GUNNAR A. GUNDERSEN, M.D., and CHARLES M. NICE, Jr., M.D.

NOCARD (13), in 1888, described a disease in cattle on the island of Guadeloupe in the French West Indies. One year later, Trevisan suggested that the responsible organism be called *Nocardia* (6), but it was not until 1943, when Waksman and Lechevalier (17) devised a new classification for the order Actinomycetales, that the term came into more general usage. Because of marked cultural differences, they separated the genus *Nocardia* from the then accepted genus *Actinomyces*.

For purposes of orientation, the phylum thallophyta is divided into the Algae and the Fungi. The latter are subdivided into the Pseudomycetes and the Eumycetes. The Pseudomycetes are then separated into the Myxomycetes, or slime molds, and the Schizomycetes, which includes all bacteria, both the true bacteria (Eubacteriales) and the forms frequently referred to as the "higher bacteria" (Actinomycetales). The order Actinomycetales, distinguished by the fact that its components show branching mycelium, includes three families: the Mycobacteriaceae, which produce branching but no mycelia and are acid-fast and aerobic; the Streptomycetaceae, which produce branching mycelium without segmentation; and the Actinomycetaceae (9).

The two genera of the family Actinomycetaceae exhibit branching mycelium but form no spirals, and they segment into bacillary and coccoid forms. *Nocardia* is sometimes acid-fast, whereas the genus *Actinomyces* is not. *Nocardia* is aerobic, while the genus *Actinomyces* is not.

In Nocard's original essay, several illustrations show how farcy (due to *Nocardia farcinica*) affects the steer. The lymph vessels on the inner surfaces of the legs, together with the regional lymph nodes, become enlarged and sometimes ulcerated (13). Lumpy masses are also found along the pectoral muscles and abdomen. From these lesions Nocard demonstrated, with the Gram-Weigert stain, coccoid and bacillary forms, which appeared dark blue. He also found that they were aerobic and noted the presence of branching mycelium. Necropsy showed these organisms in the lungs, liver, and lymph nodes. Although occurring in the West Indies and in Europe, bovine farcy has not been seen in the United States (11). Farcy is also a disease of horses, in which it is usually called glanders, and is due to another organism, *Malleomyces mallei* (12). In this country nocardiosis has been described in a terrier bitch (3) and in a German shepherd dog (16). The fungus is free living in nature and can be found on the skin of guinea-pigs and in the soil. It can also be a cause of "potato scab" (5).

NOCARDIOSIS IN MAN

Nocardiosis can be caused by any one of nine species of *Nocardia*, but in North America *N. asteroides* is the usual agent (9). This species causes an acute lung infection, which becomes chronic and has a tendency to spread to other organs. *N. madurae* and *N. pelletieri* produce a disease like actinomycosis. The infection may follow inhalation or injury. All ages are affected. The entity mycetoma pedis is more common in male laborers.

The lung infection is manifested by malaise, weight loss, afternoon fever, and mucoid sputum. The infection commonly metastasizes to the brain, as well as to the subcutaneous tissues. In the foot a small nodule forms, which ulcerates and then fails to heal. In the course of time,

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with the waxing and waning of the infection, it often burrows into deeper structures to involve bone. Abscesses develop, with the production of multiple draining sinus tracts.

Radiographically the lungs may show either small infiltrates or large lobular consolidations. The lower lobes are more frequently involved. In mycetoma pedis, there is great variation in the degree of bone destruction, proliferation of fibrous tissue, and formation of cavities and sinus tracts. When remissions occur, the patient may be asymptomatic for as long as eleven months. Despite active disease, fever may not be present. Many patients show leukocytosis, sometime up to 50,000 (18), a characteristic which aids in differentiation from tuberculosis and neoplasm. Since Eppinger (7) described the first case in man in 1890, 67 cases (2, 15, 18) have been described, and of these about two-thirds have shown brain abscesses (18). The youngest patient heretofore described was that of Stokes in 1904 (6), a 28-day-old infant, who died of the lung infection. More recently Stadler *et al.* (15) at the Mayo Clinic reported a case in a 15-month-old boy who at necropsy showed lesions in the lungs, brain, pancreas, and intercostal muscles, from which *Nocardia* could be cultured. The alimentary tract has been the portal of entry in a few cases (8).

IDENTIFICATION OF THE ORGANISM

Nocardia may be easily overlooked when staining is done for acid-fast bacteria, since some species, such as *N. madurae*, are not acid-fast. The acid-fast *N. asteroides* may be mistaken for *M. tuberculosis*. When the Gram stain is used, the coccoid and bacillary forms may simulate other organisms, especially the diphtheroids. When pus or cerebrospinal fluid which has been centrifuged is placed under a cover glass, small granules may be seen (5). These may be yellow-white, red, or black. On closer inspection they will be found to be masses of intertwining, branching mycelium varying from 0.25 to 1.0 micron in diameter. No clubs will be found, such as are seen in *Actinomyces israeli*. The granules are not firm. On smear, Gram-positive branching, bacilliform filaments resemble diphtheroids both in size and in X, Y, and V forms. With careful staining by the Ziehl-Neelsen method, and not too vigorous decolorization, 12 of 42 recognized species will be acid-fast. It is important that serous material and cerebrospinal fluid be centrifuged before attempts at identification are made.

Nocardia is aerobic and can be grown at both 20 and 37° C. The material should be inoculated on blood glucose agar, or similar enriched nutrient agar, as well as on Sabouraud's glucose agar, the pH of which has been carefully adjusted to 6.8 to 7.0. Growth appears in four to six days, with the development of irregular folded or granular, smooth or cerebriform colonies. *N. asteroides* produces light yellow to orange colonies, and *N. madurae* buff to red colonies. Most species produce no aerial mycelium.

Pathogenicity can be demonstrated by inoculation into rabbits and guinea-pigs. Nocardia does not survive concentration technics used for *M. tuberculosis*. In man no agglutinins, precipitins, or complement-fixing antibodies have been conclusively demonstrated (9). At necropsy, the organism in the acute suppurative lesions will have branching filaments, but they will not appear in the usual hematoxylin and eosin sections. The Gram stain shows them well. No granulomata, giant cells, or tubercles can be found.

CASE REPORT

A male infant, weighing 8 pounds at birth, was apparently normal until shortly after discharge from the hospital, when a cough developed, followed later by "choking spells." Although physical examination showed no abnormality, the roentgenogram revealed several pulmonary infiltrates (Fig. 1). The white blood cell count varied from 20,000 to 30,000 with 6 to 11 per cent eosinophils. Soon after admission to the hospital a papular, pustular rash appeared on the scalp, thorax, abdomen, face, and groins. After nine days Gram-positive bacilli were found in the blood culture, but were not further

identified. Antimicrobial therapy had no apparent effect on the lung disease. Later furuncles appeared on the buttocks and on the left fifth toe. At the age of three months, osteomyelitis of the proximal phalanx of the left fifth toe became evident, but the lung disease had partially regressed (Fig. 2).

Although treated by a number of chemotherapeutic agents during the next twenty months, the child was often febrile, having otitis media, a draining sinus from the left groin, and two bouts of pneumonia. Actinomyces was searched for in vain. At the age of about two years the patient was found to have multiple shotty lymph nodes, a grade III systolic murmur over the entire precordium, a few pulmonary rhonchi, palpable liver and spleen, slight clubbing of the finger nails, but no cyanosis. Mantoux, triple fungus, pancreatic enzyme, Eberthella and Salmonella agglutinin, and proteus OX19 and OX2 tests were negative. Serum protein was 8.0 gm., with globulin 5.5 gm. At the time of a recurrent pustular rash, a skin biopsy was negative. Bronchial washings showed cocci and coccobacilli in chains. At this time the lung disease progressed and the liver and spleen continued to enlarge. On five occasions *S. typhimurium* was cultured from the blood.

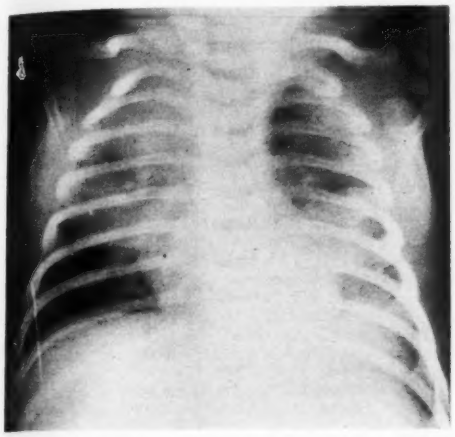

Fig. 1. Bilateral pulmonary infiltrates seen on first hospital admission at age of four weeks (Aug. 16, 1949).

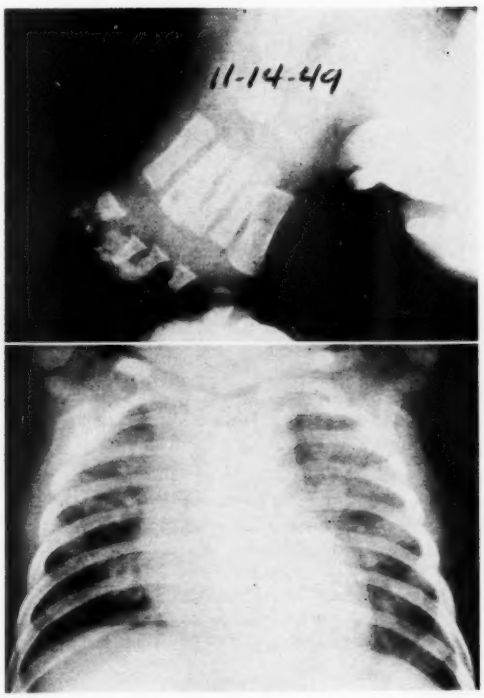

Fig. 2. Third hospital admission, at four months (Nov. 14, 1949). A. Osteomyelitis of fourth metatarsal and proximal phalanx of fifth toe. B. Improvement in roentgenographic appearance of pulmonary lesions.

Fig. 3. Eighth hospital admission, at thirty-nine months (Oct. 9, 1952). This is one of a series of roentgenograms demonstrating recurrence and persistence of the bilateral pulmonary infiltrates.

Laparotomy revealed many fibrous nodules in the liver, which were non-specific histologically. The wound healed very slowly. Shortly after his third birthday, the child again became febrile, with recurrent lung disease (Fig. 3), and calcification in the liver became apparent. During the last part of his fourth and first part of his fifth year he was asymptomatic. When the disease recurred, an electrophoretic study showed 2.6 gm. gamma globulin. After the fifth birthday, cutaneous pustules and bronchopneumonia recurred, aerobic Gram-positive rods being cultured from the pustules. Calcium deposits in the liver (Fig. 4) became more apparent.

When the patient was last admitted, late in his

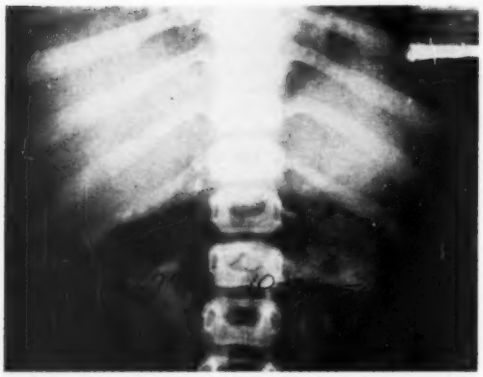

Fig. 4. Tenth hospital admission, at sixty-two months (Oct. 26, 1954). Hepatic calcifications readily demonstrated.

sixth year, culture of a fluctuant mass over the thyroid revealed *N. asteroides*, the fungus being positively identified only after death.

Necropsy: The organism was identified in sections of the lungs, liver, kidneys, and spleen. The leptomeninges were fibrinous over the base of the brain, but the fungus could not be identified.

DISCUSSION

Because appropriate antimicrobial therapy, specifically the sulfonamides, appears to halt and perhaps heal nocardiosis (2, 9), the disease deserves early recognition. It should be considered when a relatively healthy appearing child has extensive lung infection demonstrable radiographically, with pustules appearing on the skin shortly thereafter. The finding of Gram-positive cocci and bacilli in sputum, blood, and pus should be another clue. Lack of response to the newer antimicrobials may also be suggestive of a fungous infection.

In the chronic nocardial infection, the radiographic changes in the lungs and liver are probably indistinguishable from tuberculosis, but in infancy it is doubtful that the host and the Koch bacillus would live together so long as they did in this case. Caffey (4) lists echinococcal cysts, tiny stones in the biliary radicles, hemangioma, and tuberculosis as causes of hepatic calcium deposits. Margulis *et al.* (10) described calcification in hepatoma. Probably nocardiosis should be added to this list.

SUMMARY

The clinical course and radiographic story of a five and one-half year old boy who probably had nocardiosis for all but the first weeks of life have been presented.

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SUMMARIO IN INTERLINGUA

Nocardiosis: Reporto de un Caso con Breve Revista del Litteratura

Le litteratura de nocardiosis es passate in revista, e un caso es reportate que esseva observate ab brevemente post nato usque al morte del patiente in su sexte anno.

Nocardiosis pote esser causate per un numero considerabile de species de *Nocardia*, sed in America *Nocardia asteroides* es le agente usual, e le morbo es characterisate per un acute infection pulmonar que pote devenir chronic e diffunder se a altere organos. In le patiente del autor, le organismo esseva trovate al necropsia in pulmones, hepate, renes, e splen.

Radiographicamente le pulmones pote exhibir parve infiltratos o grande consolidationes lobular. In casos chronic le configuration radiographic es a vices indistinguibile ab tuberculose. Proque therapia antimicrobial—specificamente le uso de sulfonamidos—pare arrestar le progresso de nocardiosis, le prompte recognition del morbo es importante.

Differential Diagnosis of Fibrosing Lung Lesions[1]

WILLIAM R. MITCHUM, M.D.,[2] and BOYER M. BRADY, M.D.[3]

PULMONARY fibrosis, interstitial infiltrates, and prominent parenchymal vascular shadows are frequently seen in the study of chest roentgenograms. Differentiation of the strand-like shadows observed is often difficult, and the radiologist is dependent upon clinical findings and an understanding of the pathological physiology involved for proper evaluation of the roentgen changes.

The conditions which produce shadows representing or simulating pulmonary fibrosis are numerous. In this paper we shall stress the importance of correlation of clinical and roentgen findings. For this purpose the radiologic examination should be comprehensive, including fluoroscopic and multiple film studies.

Pulmonary blood vessels are responsible for the majority of normal pulmonary markings; the bronchi and adjacent connective tissue make up the remainder. The markings are largest at the hilar regions and radiate outward in the pulmonary fields, progressively decreasing in size. They are relatively sparse in the apices and lateral portions of the lungs. The shadows are straight and exhibit periodic branching as the larger vessels and bronchi divide. With films of good quality, the blood vessels can be traced from the hilar regions to the periphery, where they become indistinct.

The dilatation of pulmonary vessels which occurs in congestion of the lung or in polycythemia vera may present a roentgen appearance that can be confused with interstitial infiltration or fibrosis. With study, the shadows can be identified by their progressively decreasing size as they extend peripherally from the hilus. The dilated vessels extend farther toward the periphery than normal and are tortuous as well as elongated. The shadows are well defined and branching is readily apparent. With congestion, the heart is usually enlarged; in polycythemia it may be of normal size.

The presence of inflammation, fibrosis, tumor, and fine foreign material in the interstitial tissues of the lung may be mistaken for vascular prominence; careful study will show that there are differences.

PATTERN OF FIBROSIS AND ITS DISTRIBUTION

It is important to avoid confusing terms in describing fibrosing lesions. In the present discussion, the term "fibrotic appearance" will be used to describe the roentgen shadows being studied, whether due to fibrosis or some other interstitial process. This general designation will be modified by appropriate adjectives, such as "coarse" and "fine." The term "nodules" will indicate small discrete densities visible in lung fields along the course of or adjacent to the interstitial shadows. Clues to the disease causing the fibrotic appearance may be found by a systematic study of the shadows. Are they uniform in size? Are they modified by any other type of pulmonary disease? Are they localized to any particular region of the lung? Is the major portion in a certain area, such as the hilar region, the bases, or apices? Do they extend to the periphery of the lung?

The fibrotic appearance produced by chronic tuberculosis is not uniform in size or distribution. It may be modified by the shadows of exudative disease, cavitation, or calcifications.

Interstitial pneumonitis produced by non-tuberculous organisms rarely pro-

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[3] Resident in Radiology, University of Tennessee School of Medicine.

duces a fibrotic appearance only. The shadows are not uniform in size or distribution, and patchy areas of consolidation may be present.

A carcinoma arising from one of the major bronchi with spread into the lymphatics of the involved lobe will produce a localized fibrotic appearance. The shadows are more dense at the hilus, fanning out and decreasing in size (20).

The majority of bronchiectatic lesions are in the lung bases; small saccules or cystic areas may be seen and, superimposed on these, small areas of pneumonitis.

Boeck's sarcoid may produce a fine fibrotic appearance that involves both lungs almost in their entirety, in a symmetrical fashion.

OTHER FINDINGS ON CHEST ROENTGENOGRAMS

Systematic study of all structures seen on a chest roentgenogram will often help in making a diagnosis. The absence of a breast and presence of a prominent axillary skin fold shadow, coupled with a fibrotic appearance in the lung apex on the same side, suggest radiation fibrosis. Discovery of a destructive lesion in the thoracic cage or shoulder girdle will often indicate that a fibrotic appearance may be due to diffuse metastases. The presence of mediastinal, hilar, and intrapulmonary lymph node enlargement in conjunction with a fibrotic appearance of the lung fields brings to mind Boeck's sarcoid, metastatic carcinoma, and lymphomatous diseases. It is not always possible from chest examination alone to differentiate these conditions. Without excellent films and careful study, it is frequently difficult to distinguish hilar vascular shadows from lymph nodes. Cardiac enlargement will sometimes call attention to pulmonary congestion that may have been misinterpreted as a fibrotic process.

Hemosiderosis has many times been confused with other diseases (9), but with the cardiac configuration produced by mitral valvular disease, its presence can be strongly suspected.

The presence of an enlarged pulmonary artery calls attention to the possibility of cor pulmonale (16) and, in turn, of a chronic lung process.

A calcified or thickened pleura suggests old inflammatory disease.

CLINICAL STUDIES

That the history and physical examination form the basis for diagnosis is an axiom in medicine. Upon these the differentiation of diseases producing fibrotic changes on the chest roentgenogram is largely dependent. Serial roentgenograms over a period of days or weeks are of especial help. The exacerbation and remission of Boeck's sarcoid, the progression of metastatic disease, and the regression of certain inflammatory lesions are all of diagnostic significance. The correlation of change in symptoms with changes on the chest film is likewise important.

Laboratory tests, bronchoscopy, bronchography, and pulmonary function studies are useful adjuncts in diagnosis. In spite of clinical aids, however, pathological examination is often necessary. Thoracic surgery in recent years has made supraclavicular lymph node exploration and lung biopsy relatively hazardless; consequently, a correct diagnosis can almost always be reached.

PATHOLOGY AND PATHOLOGIC PHYSIOLOGY

The degree of impairment of respiratory function in patients with a fibrotic appearance on the chest roentgenogram depends on the pathological process present and how it interferes with the ventilatory and respiratory components of respiration (1, 29). There are sometimes differences of degree between the roentgen picture and the symptoms. It is the pattern and distribution of the fibrosis or interstitial infiltrate rather than its amount that are correlated with the clinical findings (29).

Fibrotic narrowing of bronchioles may lead to localized areas of obstructive emphysema. The resultant physiologic disturbance is ventilatory, resulting in decreased vital capacity.

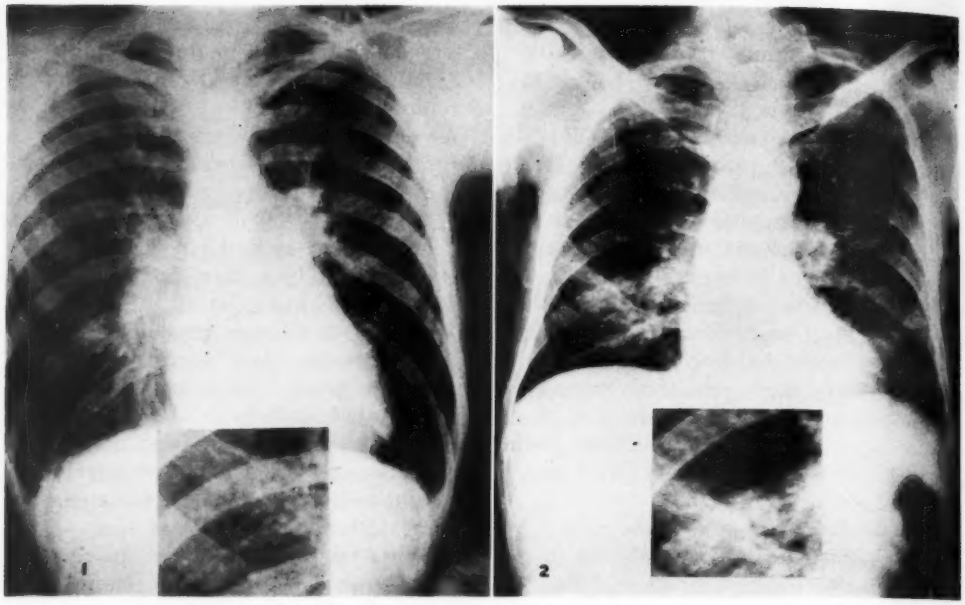

Fig. 1. Case I: Pulmonary hemosiderosis. The insert in this and subsequent illustrations is from the right mid lung field.
Fig. 2. Case II: Metastatic carcinoma.

Diffuse interstitial fibrosis of the alveolar septa is an end-stage, beginning with interstitial edema and capillary congestion. The functional changes due to the thickened alveolar wall and separation of the alveolar septal capillaries from the alveolar surface produce interference with diffusion of oxygen and carbon dioxide. Intra-alveolar fibrosis may vary from involvement of a few alveoli to an entire lobe; the associated interstitial tissue, blood vessels, and bronchioles may undergo some fibrotic changes. Extensive fibrosis destroys function and leads to secondary emphysema in adjacent lung tissue and other lobes. The functional disturbance is proportional to the degree of emphysema that develops.

Fibrosis of the pulmonary vascular bed, if extensive, will interfere with respiratory and ventilatory function.

The various patterns of fibrosis may often be seen in combination.

The following selected cases are illustrative of a few of the diseases producing a fibrotic appearance on the chest film.

CASE REPORTS

CASE I: A 35-year-old white male was admitted to John Gaston Hospital with a four-year history of rheumatic heart disease. One month prior to admission, there had been an increase in symptoms, with dyspnea predominating. The past history revealed several episodes of hemoptysis. On a chest roentgenogram (Fig. 1) the cardiac shadow presented the configuration seen in mitral valvular disease. The major hilar vessels were quite large. Along the peripheral vascular shadows, which were not increased, were small nodules of varying size and shape with hazy contours, not exceeding 4 mm. in diameter. These nodules were most prominent in the mid lung fields and less marked in the apices and bases. A diagnosis of mitral valvular disease with hemosiderosis was made. The patient responded to treatment but was lost from observation four months after discharge.

Comment: Pulmonary hemosiderosis has been confused with miliary tuberculosis, simple pulmonary congestion, Boeck's sarcoid, pneumoconiosis, and carcinomatosis (4, 9, 27). A history of hemoptysis is almost invariable. Mitral stenosis is present in an extremely high percentage of cases and produces characteristic roentgen features. There may be signs of congestive

heart failure as well. The incidence of hemosiderosis is highest in young males, while simple mitral stenosis is more prominent in young females.

The roentgen changes have been described as predominantly involving the mid and lower lung zones, with symmetrical distribution of numerous dense nodular shadows, producing an overall haziness in the lungs. The visualized nodules are composed of intracellular hemosiderin aggregated in small alveolar foci. The intervening lung is usually normal. There is no evidence of generalized fibrosis or emphysema. Hemosiderin deposits do not directly affect pulmonary function. The pulmonary lesions remain quite constant over a long period of time.

CASE II: A 64-year-old colored male entered John Gaston Hospital with a history of progressive dyspnea of a few months duration. A chest roentgenogram (Fig. 2) showed no hilar lymph node enlargement but the lung fields had a bilateral disseminated fibrotic appearance, with superimposed nodules of varying size and shape, having hazy borders. These shadows extended to the periphery of the lungs and were more confluent in the lower lung fields. Diffuse metastatic disease was suspected. The patient admitted some epigastric pain and weight loss. Gastrointestinal roentgen studies revealed a far advanced carcinoma of the stomach. Autopsy subsequently confirmed the presence of diffuse pulmonary metastases.

Comment: Diffuse metastatic carcinoma of the lung is secondary to only a few primary lesions, chiefly in the stomach, lung, pancreas, breast, colon, and gallbladder. The tumor cells may reach the lungs by a hematogenous or lymphogenous route (2, 13). The hematogenous type of disease is evenly and diffusely distributed through both lungs. The deposits appear as mottled densities with poorly defined margins and of various sizes. Subsequent invasion of lymphatic channels produces a merging into the lymphangitic pattern. Metastatic carcinoma of the lymphogenous type may involve the perivascular, peribronchial, subpleural, and pleural lymphatics. A fine fibrotic appearance is produced, with frequent interweaving of shadows. Fibrotic strands branch out from the hilus. Nodules of different sizes are present along the course of the fibrotic strands. Hilar lymph node enlargement may be noted.

Clinically, pulmonary symptoms are less frequent with a hematogenous process alone; the lymphangitic type has been described as producing severe dyspnea, cough, and even cyanosis.

Pathologically, in the lymphangitic type there are tumor cells in the various lymphatic channels extending from pleura to hilus. Larger aggregates of these cells may be found at the bifurcation of the lymphatics. The lymphatic walls may be thickened by fibrous tissue out of proportion to the amount of tumor present. The hematogenous metastases may range from small foci to very large masses. Tumor-cell emboli lodge in the pulmonary capillaries, and growth permits invasion and compression of adjacent lung parenchyma. Fibrosis of the vascular bed and interference with gas exchange in the alveoli account for functional impairment in advanced disease. It seems likely that the distinction between disseminated fine hematogenous and lymphangitic metastases is not clear-cut and that a more comprehensive descriptive term such as "disseminated lung metastases" would be preferable.

CASE III: A 60-year-old white male entered another hospital complaining of chronic cough, increasing dyspnea, and some hemoptysis, with associated weakness and fatigability. No fever had been present. A chest roentgenogram revealed extensive bilateral changes. All diagnostic aids were employed, but lung biopsy was necessary for a final decision. Figure 3A is a chest roentgenogram made eleven days after surgery. Except for pleural reaction in the right lateral chest secondary to the operative procedure, it showed no change from the admission film. The heart was not enlarged; the main pulmonary artery segment and hilar vessels were prominent. A dense fibrotic pattern was seen throughout the greater part of the right lung and the upper two-thirds of the left lung. Within the fibrotic pattern were numerous solitary and confluent nodules. There were pleurodiaphragmatic adhesions bilaterally, with some basal emphysematous changes.

Pathologic examination revealed a non-specific focal interstitial pulmonary fibrosis, with areas of

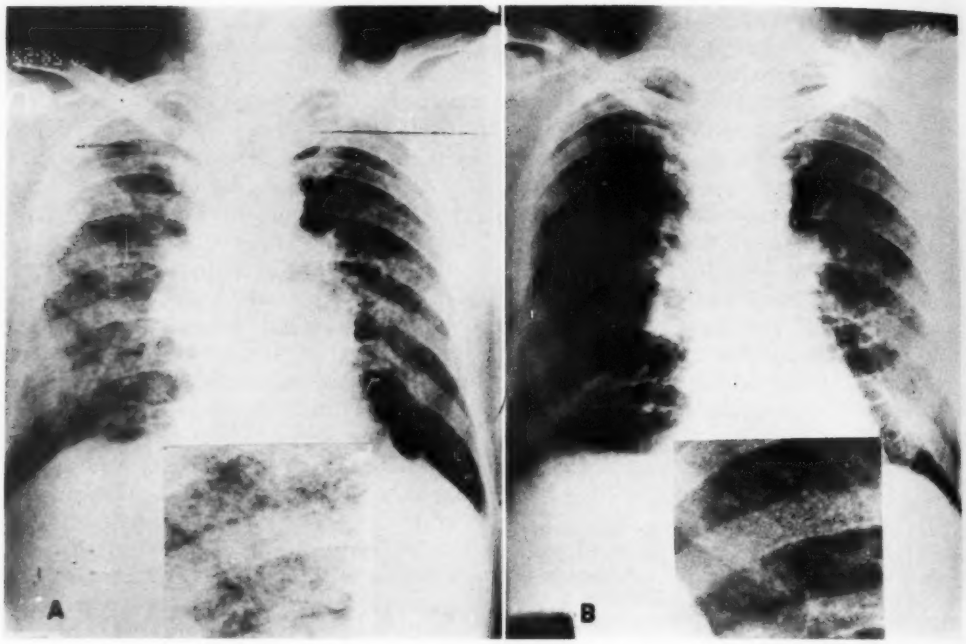

Fig. 3. Case III: Idiopathic pulmonary fibrosis (Hamman-Rich disease). A. Roentgenogram obtained eleven days after biopsy. B. Roentgenogram obtained one year after institution of treatment with cortisone.

emphysema in the uninvolved lung. Cortisone therapy produced clinical and x-ray improvement in a relatively short time, and with its continuation respiratory symptoms remained mild. Chest roentgenograms (Fig. 3B) made one year after initiation of treatment showed marked clearing of the extensive pulmonary disease, with a minimal fibrotic appearance remaining. The patient was found to have monocytic leukemia a few months before this film was made, and subsequently died of that disease.

Comment: Idiopathic pulmonary fibrosis, or Hamman-Rich disease, has been recognized more frequently in recent years (12, 20, 23). It is a progressive disease characterized by an acute onset with dyspnea, cough, and sometimes cyanosis. Dilatation and hypertrophy of the right ventricle may occur over a short period of time, leading to cor pulmonale. There is wide-spread connective-tissue hyperplasia throughout the interstitial tissue, with thickening of the alveolar walls. The alveoli contain little or no inflammatory exudate. Pulmonary function is impaired by the separation of the alveolar capillary bed from the alveolar surface, which interferes with gas exchange, and is further reduced by the presence of emphysema. Roentgenographically, in the early stages, there is prominence of lung markings, which increase in size, producing linear shadows with a fibrotic appearance. Some small nodules superimposed on the fibrous network become evident. In late stages, nodules may become confluent, and thick fibrous strands may occupy a large portion of the lung volume. Areas of emphysema frequently become prominent. Cortisone has been reported to give marked symptomatic improvement, with some clearing of the pulmonary changes, indicating a degree of reversibility of the process (25).

CASE IV: A 39-year-old female was first seen with dyspnea and fatigability of four months duration. A chest roentgenogram was interpreted as showing possible pulmonary tuberculosis, and the patient was hospitalized for diagnostic studies. There was a past history of rheumatoid arthritis for thirteen years and peripheral joint symptoms were present at the time of admission. Tuberculosis was never diagnosed. The chest roentgenogram (Fig. 4) showed irregular marginal erosion of both humeral heads.

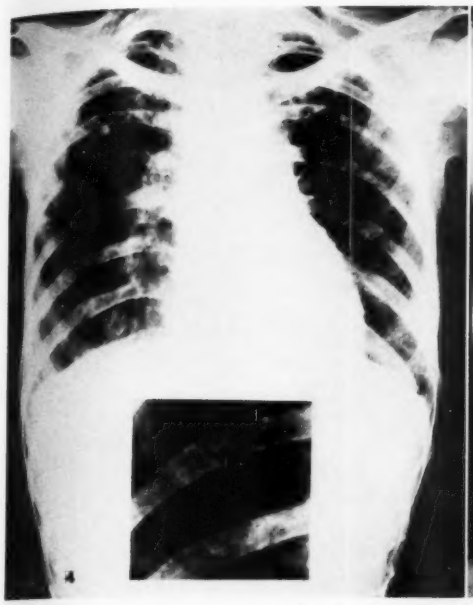

Fig. 4. Case IV: Rheumatoid arthritis.

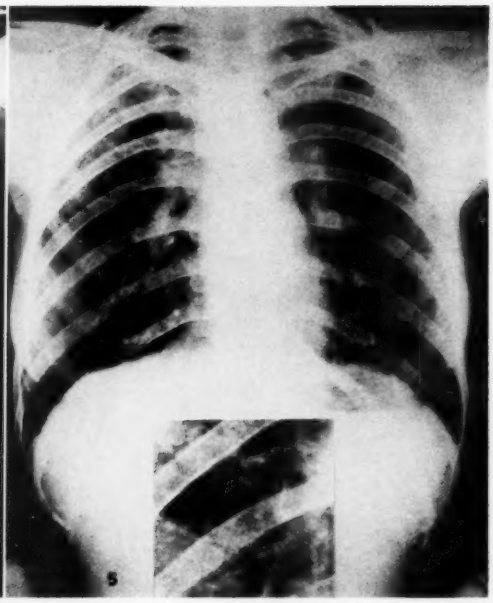

Fig. 5. Case V: Boeck's sarcoid.

with scattered areas of calcium deposition related to the joint capsules and tendinous attachments. Amorphous calcification was seen between the right scapula and first rib. The heart was not enlarged, but the pulmonary artery segment was somewhat prominent. There was an irregular fibrotic appearance of the interstitial markings bilaterally, most pronounced in the apices, with wider strand shadows merging into the thickened apical pleural caps. A bronchogram revealed no definite bronchiectasis. Peripheral joint manifestations of rheumatoid arthritis were not marked, although there were calcium deposits in both elbows and wrists. The patient was subsequently discharged.

Comment: The association of lung changes with rheumatoid arthritis has been recorded infrequently (3, 20). Findings on chest roentgenograms have been described as fibrotic appearance of a linear type, sometimes with bronchiectasis asssociated. Microscopically, areas of interstitial bronchopneumonia and alveolar fibrosis are reported. In the above case there was also evidence of previous vitamin D "intoxication," with areas of periarticular calcific deposits (19). Apparently there was enough pulmonary fibrosis in this instance to produce symptoms. It must be borne in mind that rheumatoid arthritis is a generalized disease, and attention to its manifestations should not be limited to joints.

CASE V: A 27-year-old white female entered another hospital for diagnosis, because of an abnormal chest film. She had been in excellent health until four weeks before, when she began to experience shortness of breath, pain in the mid scapular region, and a productive cough, which persisted. An admission roentgenogram of the chest (Fig. 5) showed a normal heart, bilateral lymph node enlargement, and a diffuse fine reticular fibrotic appearance, which involved all portions of the lungs. Superimposed were a multitude of tiny nodules, which in some regions coalesced to produce larger nodules. Several tuberculin and histoplasmin skin tests were negative. Lung biopsy was necessary for diagnosis and revealed Boeck's sarcoid.

Comment: Boeck's sarcoid is a chronic disease characterized by remissions and exacerbations (15, 21, 22). Young adults are usually affected, and a large percentage of the patients are Negroes. The clinical manifestations vary with the organs involved and can change in the same individual during the course of the disease. In the majority of cases roentgenograms reveal changes in the intrathoracic lymph nodes and pulmonary markings. Peripheral

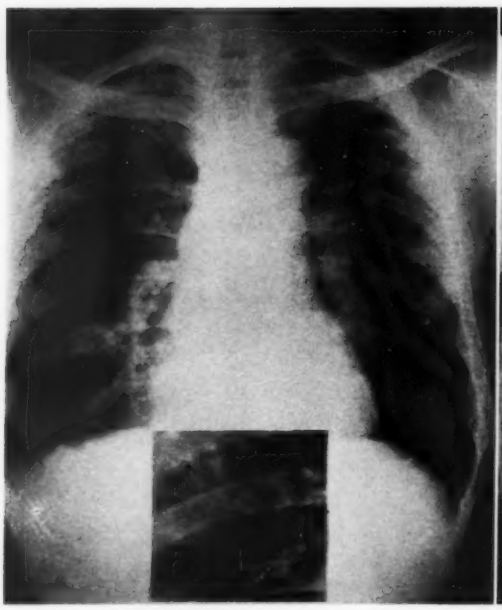

Fig. 6. Case VI: Boeck's sarcoid with bronchiectasis.

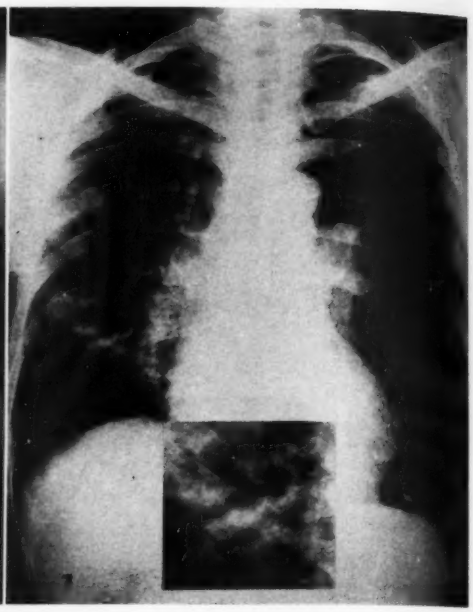

Fig. 7. Case VII: Bronchiectasis.

lymph node enlargement, bone changes, liver and spleen hypertrophy, eye changes, and lacrimal and salivary gland involvement occur in varying degree, frequently undergoing spontaneous regression. Lung findings are variable as to extent, character, and location. There is a tendency to bilateral involvement with diffuse, widespread distribution, although at times the lesions may be more localized, usually in the mid lung regions. Numerous discrete nodular foci may occur throughout the lungs, resembling miliary tuberculosis; there may be a diffuse or localized fibrotic appearance simulating other fibrosing lesions. Patchy areas of coalescent nodular foci are also seen. The fundamental pathologic process consists in the deposition of numerous epithelial tubercles of a non-caseating type, primarily in the interstitial tissues. The granulomatous lesions involve the walls of small bronchioles, often with fibrosis and thickening. Functionally, bronchiolar wall involvement produces varying degrees of obstructive emphysema. The majority of patients show an increased sedimentation rate and an increase in serum globulin. Only a small percentage give positive tuberculin tests.

CASE VI: A 55-year-old colored male entered the John Gaston Hospital with a three-year history of shortness of breath, which had become more severe in the past two weeks. He complained also of cough, productive of frothy sputum. There was mild clubbing of the fingers, and raised hyperpigmented nodules had been present on the legs for two years. Biopsy of a skin nodule revealed changes compatible with Boeck's sarcoid. A chest roentgenogram (Fig. 6) showed mild intrapulmonary lymph node enlargement. There was a fine fibrotic appearance in the lower two-thirds of each lung, extending to the periphery, and small hazy nodules were seen as well. The upper third of each lung revealed a coarser strand fibrosis extending from the upper hilar regions, superiorly and laterally. Within the strands were small, poorly defined cystic areas. Bronchography revealed saccular bronchiectasis in the superior areas. There were sarcoid changes in the hands and feet. The patient is now receiving cortisone therapy and is showing symptomatic improvement.

Comment: The advanced fibrotic appearance of the lungs in this patient is compatible with a longer history of sarcoidosis. In addition, bronchiectasis was present in the apices. The case is a good example of intrapulmonary lymph node enlargement, manifest as an "apparent"

enlargement of the descending pulmonary artery shadows. The pulmonary artery is not actually identifiable, its shadow being enlarged and lobulated. At the distal portion of the adenopathy is a rather sharp border between actual enlarged nodes and the emerging smaller pulmonary artery branch—the so-called "squaring effect." Actually, this shadow is separate from the right heart border (32).

Apical bronchiectasis has often been confused with tuberculosis (26). Localized dense fibrotic markings are seen extending from the hilar regions superiorly and laterally on the chest roentgenogram. Air-filled bronchi and a honeycomb appearance may suggest the true nature of the process. Although the bronchial process is the same as that seen in basal bronchiectasis, the clinical findings are limited, due to the adequacy of bronchial drainage. Hemoptysis may be the only symptom if, indeed, any is present. A positive tuberculin test or history of healed tuberculosis may be a clue to the origin of the condition. Hemoptysis and bronchiectasis have been reported in association with Boeck's sarcoid (22).

CASE VII: A 44-year-old colored male was first admitted to John Gaston Hospital because of fever and shortness of breath. He gave a history of respiratory infections and dyspnea for six years. A diagnosis of bronchiectasis and pneumonia was made and treatment was given accordingly. There were five subsequent admissions for pneumonia. A chest roentgenogram (Fig. 7) showed the heart not to be enlarged; the pulmonary artery segment and major hilar vessels were accentuated. There was a dense fibrotic appearance in the lower portions of both lung fields, more extensive on the right. Patchy areas of consolidation were present as well. Cystic areas of varying size, some with air-fluid levels, were noted. Bronchograms revealed marked saccular and cylindrical bronchiectasis involving portions of all lobes on the right and the lower lobe on the left.

Comment: Bronchiectasis is a chronic disease (20, 24), characteristically involving groups of adjoining bronchi of a segment or lobe, the uninvolved bronchi being normal. The surrounding parenchyma is usually abnormal, showing atelectasis, fibrosis, organized pneumonitis, or focal emphysema. Clinically, there is a tendency toward a chronic cough with abundant sputum, recurrent episodes of infection, and hemoptysis. The pathogenesis is related to bronchial inflammation, atelectasis, active pneumonitis, and fibrosis (14). A history of bronchial obstruction is obtainable in some patients. On roentgenography, the right lower and middle lobes, the left lower lobe, and the lingular segment of the left upper lobe are those usually involved, either singly or in combination. Areas of atelectasis and pneumonia may be superimposed on the dense fibrotic appearance produced. When pneumonitis is present, dilated, air-containing bronchi may be seen in the region. Dilated saccules also occur, demonstrable as irregular radiolucent areas, often with air-fluid levels. Dense pleural adhesions may produce diaphragmatic irregularities. The fibrotic appearance varies from fine markings to coarse strands, depending on the severity of the process. Bronchography is diagnostic. With considerable bronchial involvement, ventilatory function may be impaired.

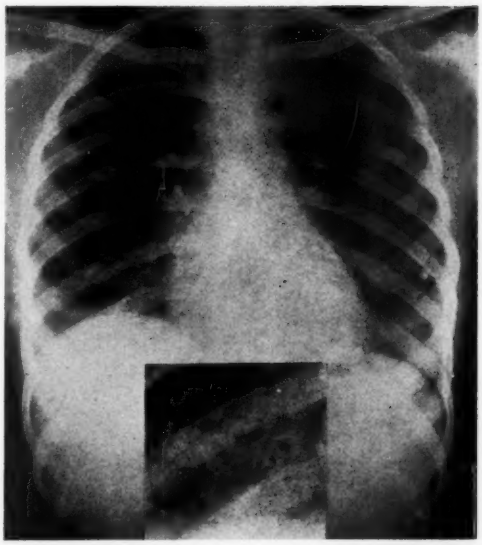

Fig. 8. Case VIII: Scleroderma.

CASE VIII: A 20-year-old colored female was seen in the John Gaston Hospital Out-Patient Department because of hyperpigmentation of the forearms and pain in the wrists. The skin over both

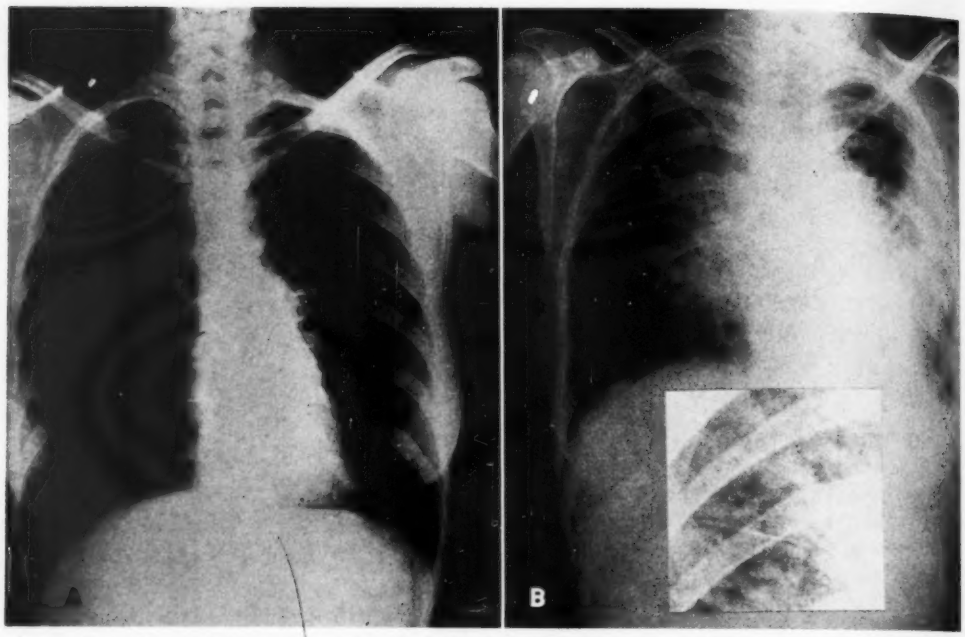

Fig. 9. Case IX: Radiation pneumonitis. A. Original chest film, showing normal lung fields. B. Roentgenogram obtained shortly before death, showing disseminated peribronchial pneumonitis.

forearms was indurated and hyperpigmented. Skin biopsy revealed scleroderma. A chest roentgenogram (Fig. 8) showed a fine reticular fibrotic appearance involving the medial bases of both lungs, extending to the diaphragm. A film of the abdomen suggested the presence of very small cystic spaces scattered throughout the areas of fibrosis immediately above the diaphragm. The alimentary tract was negative on roentgenological study. Cortisone therapy was instituted, but the patient failed to return for follow-up.

Comment: Scleroderma is a systemic disease of the connective tissue, involving the skin, subcutaneous tissues, and internal organs (10, 18, 28). The diagnosis is often made by skin biopsy. Pulmonary involvement is quite common. On the roentgenogram, there is a diffuse fibrotic appearance, more marked in the lower lung fields. A fine reticular pattern extends from the cardiac border, with a tendency to spare the apices and lateral bases. Small nodulations along the fibrotic strands have also been described, as well as a "spongy" appearance (10). Pathologically this picture represents a subpleural cystic formation due to alveolar fibrosis, bronchiolar proliferation, and destruction of alveolar walls (11). The basic lung change is an increase in collagen fibers, with thickening of alveolar septa. Symptomatology depends on the tissues involved. Dyspnea, cough, and a tendency to respiratory infections are prominent with lung involvement. Severe pulmonary disease will produce dyspnea due to interference with gas exchange in the alveoli. The finding of characteristic skin changes and roentgen evidence of esophageal, gastric, and small bowel abnormality aid in diagnosis. Roentgen examination also demonstrates changes in the heart, phalanges, soft tissues, and teeth (18). Manifestations of several collagen diseases may occur in the same patient (10). It has been observed that pulmonary symptoms frequently precede skin changes; consequently, consideration of this disease when there is roentgen evidence of a fine basilar fibrotic appearance may lead to the diagnosis.

CASE IX: A 40-year-old white female was first seen in the spring of 1954, complaining of cough, back

pain, and fever. Although the original roentgenographic studies failed to reveal a definite mass, bronchographic studies demonstrated a stenosing lesion of the left lower lobe bronchus. An exploratory thoracotomy showed this to be a bronchogenic carcinoma. The lobe was resected, but there was residual tumor. The patient was referred to John Gaston Hospital for rotational radiation therapy to the left hilus on August 17, 1954. Through a treatment portal of 8 × 12 cm. (measured at 50 cm.), 3,750 r were delivered to the axis of rotation. A target-tumor distance of 60 cm. was used, with a radiation quality of 2.0 mm. Cu h.v.l. and fractionation over a twenty-one day period. Therapy was discontinued because of the development of a severe esophagitis. This gradually subsided, and the patient remained in satisfactory condition, with negative chest roentgenograms, until November 1954, when progressive weakness, cough, and dyspnea developed, leading to death in a few days in another hospital. The original chest roentgenogram (Fig. 9A) revealed negative lung fields, although the left hilus was prominent. A roentgenogram (Fig. 9B) obtained shortly before death showed the upper two-thirds of the right lung and the left mid lung field to be involved by disseminated, patchy, peribronchial pneumonitis with numerous areas of coalescence intermingled with areas of aerated lung. Pleural fluid or thickening was present at the periphery of the left lung.

Comment: Pulmonary changes following radiotherapy vary from pneumonitis to fibrosis (7, 30, 31). Diagnosis is dependent upon the history of treatment. In general, the severity of the changes varies directly with the amount of radiation given and with the size of the portals. Irradiation over the mediastinum and great vessels is more likely to produce serious injury than over the lung periphery. Elderly persons with arteriosclerosis are especially liable to damage. The above case did not show a fibrotic appearance, but it does represent an early phase in a fibrosing process. The pattern of pneumonitis is roughly that of the field around the axis of rotation. Serial roentgen films made before, during, and after therapy are important from the standpoint of tumor regression and for the differentiation of changes due to radiation therapy, infection, and metastatic disease. Some authors believe that the fibrotic changes seen in the lung fields after therapy many times represent metastatic disease (31). Symptoms may occur before roentgenographic changes are apparent, with cough, dyspnea, and chest pain predominating. Fever may be present. With severe lung damage, the symptoms may persist, with development of progressive dyspnea, associated with repeated respiratory infections and blood-streaked sputum.

Roentgenologic study in radiation pneumonitis reveals patchy areas of consolidation in various degrees of confluence, radiating from the hilus. Pleural effusion may also occur. With subsidence of the acute reaction, there may be only a slight fibrotic appearance, associated with a few adhesions of the pleura or pericardium. With increasing damage, fibrotic changes are more extensive, occupying the fields of therapy. Pleural thickening occurs, and the heart and mediastinum may deviate to the affected side. The thoracic cage may contract as well. Microscopic changes vary from edema, swelling, and necrosis of endothelium and alveolar epithelium to a marked fibroblastic proliferation, involving chiefly the alveolar wall and interfering with gas exchange. The use of cortisone in the prevention of radiation fibrosis has been advocated (8).

CASE X: A 42-year-old white male entered another hospital because a routine film made by the State Health Department revealed evidence of pulmonary disease. He had no complaints but admitted an early morning cough, productive of a small amount of sputum. He was employed by a clay company and was exposed to an air environment containing much dust. A chest roentgenogram (Fig. 10) revealed a fine fibrotic appearance involving all portions of the lungs bilaterally, but less marked in the apices. Numerous small nodules were adjacent to and superimposed on the fibrotic strands. In the right upper lung field was a more confluent density resembling an early tuberculous lesion. Neither tuberculosis nor any other disease could be established, and the patient was discharged with a diagnosis of probable pneumoconiosis, type undetermined.

Comment: The diagnosis of inhalation diseases of the lung is also dependent on the history, either of occupational exposure or of an acute process secondary to inhalation of noxious gases or liquids

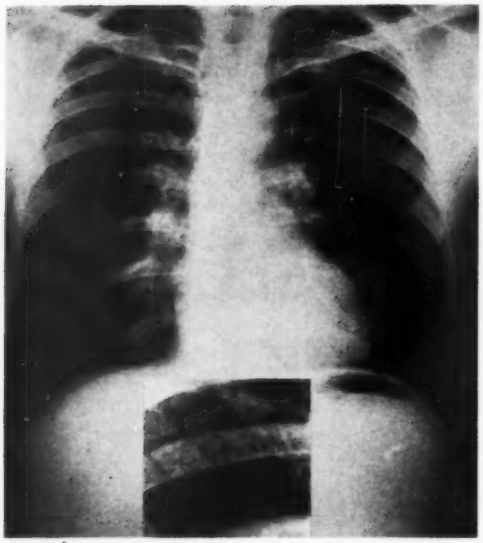

Fig. 10. Case X: Pneumoconiosis.

(17, 20). The present case may well represent one of the pneumoconioses, although specific identification cannot be made. The fact that too many diagnoses of pneumoconiosis have been made because of an abnormal chest roentgenogram plus an occupational history has been emphasized (17). Roentgen changes vary from a fine fibrotic or nodular appearance to massive opacities of irregular size and shape and have been adequately described elsewhere (17, 20). Functional impairment varies with the chronicity of the process, the degree of fibrosis and emphysema associated, and the presence of superimposed infection. The more acute conditions, which are secondary to irritative gas inhalation, resemble various degrees of pulmonary edema and patchy lobular pneumonia roentgenographically. Pathologically, the tissue reaction resulting from minute foreign bodies has been seen in the peribronchial and perivascular connective tissue along the lymphatics, in the lymph nodes, and in the alveolar interstitial tissue. Alveolar phagocytes carry off the foreign material along the lymphatics. Lymphatic obstruction by fibrosis and large groups of phagocytes allows larger amounts of foreign material to build up in the lung parenchyma.

DISCUSSION

Differential diagnosis of fibrosing lung lesions is dependent on a correlation of clinical, roentgenologic, physiologic, laboratory, and pathological findings. The roentgenologist is responsible for a systematic fluoroscopic and film study, but in only a few instances will he feel sure of the etiology of a fibrotic appearance on chest roentgenograms without additional information. Some knowledge of physiology may be obtained by fluoroscopic study of diaphragmatic and mediastinal movements. Serial and multiple projection films should be obtained to establish the pattern, distribution and symmetry of the fibrotic appearance and to determine whether it is modified by other lung disease and whether it changes with time. A study of the soft tissues, bony structures, heart, mediastinum, diaphragm, and pleura may furnish additional information. Special procedures, as bronchography and contrast examination of the alimentary tract, may be helpful in reaching a diagnosis. Information afforded by the age, sex, race, a complete history, and physical examination of the patient should be utilized. If possible, the presence or absence of an inflammatory or neoplastic process should be established. Many times the condition can be classified in a broad group of disease processes. The surgeon is often of great help through the use of bronchoscopy and skin, lymph node, or lung biopsy. The study of pulmonary function is being utilized more often and can frequently broadly categorize the disturbance in respiratory function. The pathologist, through laboratory tests and microscopic tissue examination is often responsible for the final diagnosis. It cannot be overemphasized that the utilization of all these procedures is essential in making a diagnosis.

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SUMMARIO IN INTERLINGUA

Diagnose Differential de Fibrotisante Lesiones Pulmonar

Fibrosis pulmonar, infiltratos interstitial, e prominente umbras parenchymo-vascular es vidite in roentgenogrammas in un varietate de conditiones. Illos produce un apparentia que es designate in iste reporto como "fibrotic." In tal casos le diagnose differential es frequentemente difficile. Un comprehensive studio roentgenologic—incluse fluoroscopia e pelliculas multiple—es indispensabile, sed le diagnose final require un correlation con constatationes clinic, physiologic, laboratorial, e pathologic.

Le conditiones que debe esser prendite in consideration es inflammationes (tuberculose, morbos fungal, bronchiectasis), tumores maligne, fibrosis a radiation, sarcoide de Boeck, morbos collagenic, morbos de inhalation, hemosiderosis, e fibrosis idiopathic.

Dece seligite casos es presentate.

Roentgen Findings in Patients with High Serum Calcium

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THE ROENTGEN manifestations in 75 patients with hypercalcemia have recently been reviewed at The John Hopkins Hospital. This series represents patients studied by the Department of Endocrinology and also patients with a high serum calcium reported by the Chemistry Laboratory during the year 1952. Only cases for which sufficient clinical information, satisfactory films, and conclusive evidence of hypercalcemia were available were included. The distribution of cases according to etiology with the range of serum calcium determinations for each group is presented in Table I.

TABLE I: DISTRIBUTION OF PATIENTS WITH HYPERCALCEMIA BY ETIOLOGY

Etiology	Number of Cases	Range of Average Serum Calcium		
		Low	High	Average
Multiple myeloma	11	11	14	12.7
Cancer of the breast	8	11	13	12
Cancer of the lung	4	13	16	13.7
Miscellaneous malignant lesions	8	11	18	13
Hyperparathyroidism	14	11	16	12.6
Thyrotoxicosis	6	11	14	11.8
Hypervitaminosis D	4	11	17	13
Cushing's disease	1	..	..	12
Postmenopausal osteoporosis	1	..	..	11.5
Paget's disease	1	..	..	11.5
Sarcoid	5	11	14	12
Undetermined	12	11	14	12

The roentgenologic skeletal findings fell into five categories: (*a*) focal and disseminated lesions, (*b*) malacic lesions, (*c*) porosis, (*d*) changes characteristic of Paget's disease, and (*e*) absence of roentgen skeletal abnormalities.

FOCAL AND DISSEMINATED LESIONS

Multiple osteolytic foci, varying in size and dissemination and without surrounding bony reaction, were the predominant feature in this series of patients. All of these lesions proved to be of neoplastic origin. Widely disseminated destructive changes were most frequent in multiple myeloma (Fig. 2) and less frequent in other malig-

TABLE II: ROENTGEN FINDINGS IN THE MALACIC GROUP

1. General appearance of bone
   - (*a*) Decreased density with coarse, fibrous effect.
     Resorption of secondary trabeculae with thickened, poorly defined primary trabeculae.
2. Changes during active growth
   - (*a*) Disappearance of metaphyseal plate and epiphyseal cortex.
   - (*b*) Widening of radiolucent zone between metaphysis and epiphysis.
   - (*c*) Cupping, fraying, and widening of metaphysis.
3. Osteoid, fibrous tissue, and osteoclastic manifestations
   - (*a*) Pseudocysts due to osteoclasts and fibrous tissue. Usually calcify on healing.
   - (*b*) True cysts—usually fluid filled. Do not calcify on healing.
4. Subperiosteal resorption
   - (*a*) Cortical erosion forming a palisade-like lacework, frequently seen in the midphalanges but sometimes elsewhere.
   - (*b*) Resorption of ungual tufts.
   - (*c*) Resorption of lamina dura.
5. Skull
   - (*a*) Coarse resorption of inner and outer tables producing a mottled effect. A cotton-woolly effect produced by retention of islands of normal bone density. Thickening of calvarium. Rarely, cyst formation.
6. Plasticity in reaction to trauma and stress
   - (*a*) Softening: bowing, decreased stature, protrusio acetabuli, platybasia, "fish vertebra," flat pelves, folded rib fractures (cortical margins not visible).
   - (*b*) The Milkman-Looser zones—symmetrical pseudofractures.
   - (*c*) Greenstick fractures.

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TABLE III: CAUSES OF BONE MALACIA*
(Abnormality in Mineral Metabolism)

I. Nutritional
  A. Vitamin D lack—Rickets
  B. Mineral and Vitamin D lack—Osteomalacia
  C. Vitamin D resistant—Refractory rickets
  D. Gastrointestinal tract disease
    1. Steatorrhea
      (*a*) Celiac disease.
      (*b*) Sprue.
      (*c*) Pancreatitis; rarely, carcinoma of the pancreas.
      (*d*) Biliary stenosis or atresia.
    2. Short-circuiting operations
      (*a*) Inadvertent gastro-ileostomy.

II. Renal disease
  A. Glomerular osteonephropathy
    1. "Renal rickets" (renal dwarfism, renal osteodystrophy)
      (*a*) Due to chronic nephritis, polycystic kidneys, pyelonephritis, congenital obstructions of the bladder neck, bands, valves, and others.
  B. Tubular osteonephropathy
    1. Renal acidosis—lack of ammonia formation
    2. de Toni-Fanconi syndrome—amine diabetes, failure to absorb certain amino acids including cysteine; also phosphates, and glucose. Considered to be a proximal tubular defect.

III. Endocrine
  A. Hyperparathyroidism

* Modification of Albright's classification (1).

nant neoplasms, such as carcinoma of the breast. In a few cases of breast cancer, osteoblastic metastases were observed.

Of some interest is the occurrence of high serum calcium in such a wide selection of neoplastic diseases. In addition to those mentioned in the preceding paragraph, 1 case each was encountered of melanosarcoma, Ewing's tumor, carcinoma of the penis, carcinoma of the gallbladder, undifferentiated carcinomatosis, undifferentiated lymphoid disease, and chronic lymphatic leukemia. (Two patients with multiple myeloma and 6 with carcinoma of the breast received hormonal therapy which probably influenced the serum calcium levels. This influence is not felt to be the important factor, since most of these patients had hypercalcemia before treatment was started.)

TABLE IV: ROENTGEN FINDINGS IN THE POROTIC GROUP

1. General appearance of bone
  (*a*) Diminished density with sharp, clear, thin cortical and trabecular outlines.
2. Cortical and trabecular resorption
  (*a*) Endosteal cortical resorption leaving sharp thin cortical lines—pencilling effect.
  (*b*) Thinning of primary and secondary trabeculae.
    (1) Ground-glass appearance in areas of fine, closely packed trabeculae.
    (2) Filigree appearance in areas of large, more widely spaced trabeculae.
  (*c*) Lamina dura thin but present.
3. Reaction to trauma and stress:
  (*a*) Brittle fractures and infractions.
  (*b*) Fish-mouth vertebrae.
  (*c*) Folded rib fractures (cortical margins distinct).
  (*d*) Dislocation of epiphysis along with the metaphyseal plate (scurvy).

MALACIA

Generalized decreased bone density with a coarsened fibrous effect and an indistinct fuzzy appearance of the cortices constitutes the essence of the roentgen manifestations of the malacic group (Fig. 3). In more detail, the changes are as shown in Table II.

From a roentgen point of view, the differential diagnosis of malacic bone disease should include renal and nutritional causes of rickets as well as hyperparathyroidism (Table III). However, due to the fact that in each of the rachitic diseases the serum calcium is normal or reduced, the presence of a high serum calcium narrows the possibilities to hyperparathyroidism. In this series when the bones were observed to fulfill the criteria of the malacic group, the diagnosis proved to be exclusively hyperparathyroidism, except for 5 cases in which a final clinical diagnosis has not yet been established.

POROSIS

Generalized decreased bone density with thin, sharply defined trabecular pattern

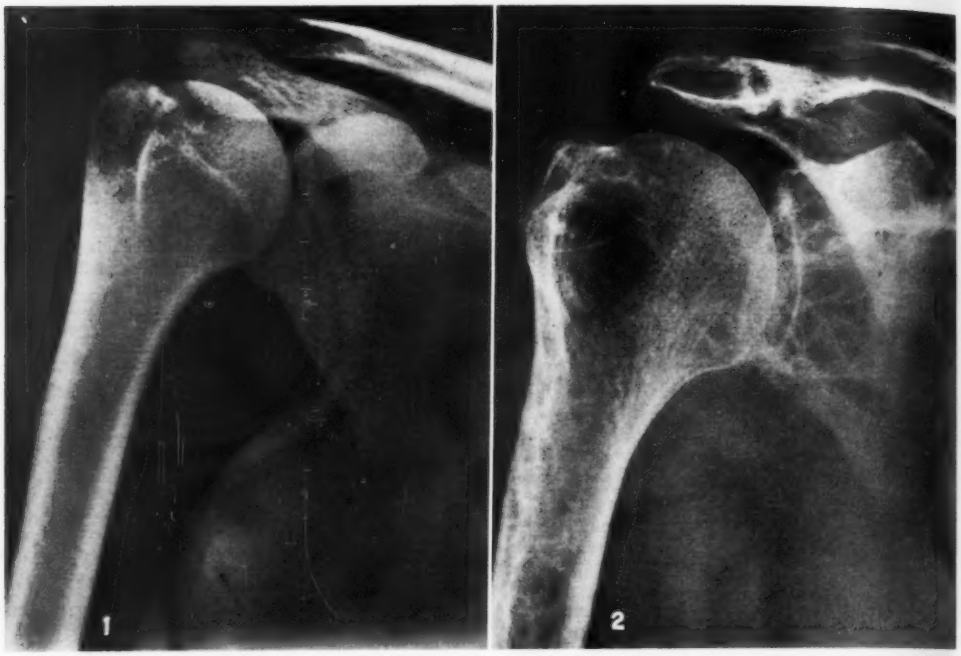

Fig. 1. Normal case showing thick cortical bone and regular trabecular pattern.
Fig. 2. Disseminated focal lytic lesions in a case of multiple myeloma.

giving a pencilling effect or, in fine textured bone, a ground-glass appearance characterized the porotic group (Fig. 4). A detailed analysis of these changes is presented in Table IV.

When the bones are observed to fulfill the criteria of porosis, the theoretical range of diagnostic possibilities, without consideration of the increase in serum calcium, might include any condition which inhibits the formation or depletes the reserve of organic bone matrix. Table V lists a few such diseases.

Actually, within the framework of this study of patients with hypercalcemia, only a few causes of bone porosis emerged. Three causes included in the original classification were thyrotoxicosis, Cushing's syndrome and postmenopausal osteoporosis. Four patients with hypervitaminosis D also had osteoporosis. Since all of these patients suffered from some form of arthritis and their porosis may have been secondary to debility and disuse, the relationship between the vitamin D intoxication and the osteoporosis is open to question; however, there is no question that

TABLE V: CAUSES OF BONE POROSIS*
(Abnormality in Osteoid Metabolism)

I. Congenital
  (*a*) Osteogenesis imperfecta.
II. Lack of stress and strain
  (*a*) Atrophy of disuse.
III. Endocrine
  (*a*) Estrogen lack.
    (1) Postmenopausal state.
    (2) Congenital hypoestrinism: ovarian agenesis.
  (*b*) Androgen lack.
    (1) Eunuchoidism.
  (*c*) Cushing's syndrome.
  (*d*) "Alarm" reaction.
  (*e*) Hyperthyroidism.
  (*f*) Hypothyroidism.
  (*g*) Acromegaly.
  (*h*) Simmond's disease.
IV. Nutritional
  (*a*) Vitamin C deficiency.
    (1) Scurvy.
  (*b*) Malnutrition.
V. Degenerative
  (*a*) Senile osteoporosis.
VI. Unknown

* Modification of Albright's classification (1).

Fig. 3. Malacic changes in a case of hyperparathyroidism. Note the coarse, fuzzy pattern and extensive subperiosteal resorption.

Fig. 4. Osteoporosis in a case of Cushing's syndrome. Trabecular and cortical lines are thin and sharp. Cortical resorption has taken place mainly from the endosteal side.

the hypercalcemia was caused by overdosage of Vitamin D in these cases (3).

It is noteworthy that, of the 6 patients with hyperthyroidism encountered, 2 had some degree of osteoporosis. In retrospect, 4 of these 6 cases showed a rather distinctive configuration of the heart—somewhat resembling a ham (4). This may be due to pulmonary arterial and left ventricular enlargement secondary to increased blood flow.

In addition, porotic changes are frequently encountered in malignant diseases. These changes are usually due to metabolic factors but in an occasional case of multiple myeloma may be attributable to finely disseminated lesions. In one borderline case of decreased density which was interpreted as porotic, hyperparathyroidism proved to be the cause. Three cases in which the bones were adjudged porotic await clinical diagnosis.

PAGET'S DISEASE

One case of Paget's disease with typical roentgen findings was encountered in our series of cases. Hypercalcemia is a transient phenomenon in these patients, occurring when they are put at rest. For this reason, the orthopedic surgeon must beware of calcium intoxication when immobilizing a fracture patient who suffers from Paget's disease (1).

NO ROENTGEN SKELETAL ABNORMALITIES

In 22 of the 75 cases studied, no roentgen skeletal abnormalities were found. This group included 5 cases of undetermined etiology, 5 of sarcoidosis, 5 of hyperparathyroidism, 4 of thyrotoxicosis, and 3 of malignant disease. Actually 10 cases of sarcoid with rather typical changes in the lungs were encountered. Of these, 5 had to be discarded because of the fact that in each only one high serum calcium

TABLE VI: ROENTGEN FINDINGS IN PATIENTS WITH HIGH SERUM CALCIUM

Predominant Skeletal Roentgen Finding	Disease Category	Etiology	Number of Cases
Focal and disseminated, usually lytic, lesions suggesting neoplasia	Malignancy	Myeloma	11
		Cancer of the breast	8
		Cancer of the lung	2
		Miscellaneous	4
Generalized decreased bone density with coarse trabecular pattern	Malacia	Hyperparathyroidism	8
		Undetermined	4
Generalized decreased bone density with fine trabecular pattern	Porosis	Thyrotoxicosis	2
		Hypervitaminosis D	4
		Cushing's disease	1
		Postmenopausal osteoporosis	1
		Hyperparathyroidism	1
		Undetermined	3
		Miscellaneous malignant lesions	3
No roentgen skeletal abnormalities	Sarcoid	Sarcoid	5
	Malacia	Hyperparathyroidism	5
	Indeterminate	Undetermined	5
	Porosis	Thyrotoxicosis	4
	Malignancy	Cancer of the lung	2
		Leukemia	1
Paget's disease			1

was reported among several determinations. This sporadic finding of high serum calcium may represent a characteristic of the disease rather than a laboratory error. The punched-out lesions in the central medullary canal at the distal ends of the phalanges which are typical of bony involvement by sarcoidosis were not observed in any of the cases included in this study.

DISCUSSION

A group of patients whose only common denominator was hypercalcemia has been studied for roentgen evidence of bone disease. The separation of generalized diminished bone density into malacia and porosis was attempted on the basis of a classification proposed by one of the authors (D. M. G., 2). There is a tendency among radiologists to report generalized diminished bone density as demineralization or osteoporosis without trying to differentiate between malacia, which is basically a disease of mineral metabolism, and porosis, which is basically a disease of organic matrix. This omission deprives the clinician of important diagnostic data and occasionally deprives the radiologist of the satisfaction of being the first to realize the true nature of the disease.

The term "malacia" has not yet gained full recognition as being descriptive of a group of changes produced by specific diseases. It is frequently thought to be synonymous with osteomalacia (or adult rickets), just as "porosis" is frequently used interchangeably with diminished bone density. Simply stated, in malacia the bones are soft and coarse, while in porosis they are brittle and homogeneous. The two together encompass most of the processes which cause generalized diminished bone density. Our experience emphasizes the diagnostic importance of making the distinction between malacia and porosis, and also supports the inclusion of hyperparathyroidism in the roentgen category of the malacic group.

SUMMARY

The roentgenographic patterns in 75 patients with elevated serum calcium levels ranging from 11 to 18 mg. per cent formed the basis for this study. The cases could be categorized into five major groups from a roentgen standpoint. Table VI summarizes the findings.

ACKNOWLEDGMENTS: We would like to thank Dr. J. E. Howard and the Department of Endocrinology for making available the list of patients with hypercalcemia. Reproductions of the roentgenograms were supplied by LogEtronics, Inc., 500 E. Monroe Avenue, Alexandria, Va.

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SUMMARIO IN INTERLINGUA

Constatationes Roentgenologic in Patientes con Alte Nivellos Seral de Calcium

In un serie de 75 casos exhibiente hypercalcemia (11 a 18 mg pro cento), le roentgenoconstatationes skeletal representava cinque categorias: (1) Lesiones focal e disseminate, observate in casos de myeloma, carcinoma del corde e del pulmon, e miscellanee tumores maligne; (2) generalisate reduction del densitate ossee con grossier configuration trabecular (malacia), vidite in casos de hyperparathyroidismo e in 4 casos de etiologia non determinate; (3) generalisate reduction del densitate ossee con fin configuration trabecular (porosis), vidite in casos de thyrotoxicosis, hypervitaminosis D, morbo de Cushing, osteoporosis postmenopausal, hyperparathyroidismo, e varie altere conditiones; (4) nulle anormalitate skeletal, vidite in sarcoide, hyperparathyroidismo, thyrotoxicosis, carcinoma pulmonar, leucemia, e etiam in certe casos de etiologia non determinate. In plus, le serie includeva 1 caso de morbo de Paget in que hypercalcemia transiente esseva constatate.

Aneurysmal Bone Cyst: Its Roentgen Diagnosis[1]

ROBERT S. SHERMAN, M.D., and KENNETH Y. SOONG, M.D.

DURING THE PAST few decades a rather striking lesion of bone has been described in the literature under many seemingly unrelated designations: ossifying hematoma (4, 8, 28), subperiosteal giant-cell tumor (6, 13, 16, 24, 25, 27), atypical giant-cell tumor (7), aneurysmal giant-cell tumor (11), "hemorrhagic" bone cyst (2), expansile hemangioma (15), and aneurysmal bone cyst (1, 9, 10, 17, 18, 20, 21, 22). In recent years the term "aneurysmal" bone cyst has been most widely accepted. While the pathogenesis remains unsettled, there seems to be general agreement that the lesion is a distinct clinical and pathological entity, a fact established through the work of Jaffe and Lichtenstein (17, 18, 20, 21).

The roentgenographic picture has been described as showing a diaphyseal and eccentric location and a characteristically expanding, "ballooned-out" shape having multiloculations (1, 17, 20, 27). While the occurrence of these cardinal roentgen features is evident, certainly there exists a need for fuller x-ray evaluation. As yet there has been no study devoted solely to roentgen diagnosis based upon a sufficiently large volume of material to establish the appearance of the lesion at various stages of its natural course, to demonstrate atypical cases, or to indicate the effect of treatment. Naturally, the ability to recognize these variations is a matter of importance to the diagnostic roentgenologist. The purpose of the present study is to evaluate the prevailing concept of roentgen diagnosis and, if it appears to be indicated, to enlarge on the roentgen criteria as concerns the unusual cases, natural history of the disease, and influence of surgery and irradiation.

MATERIAL AND METHODS

Forty-three histologically proved aneurysmal bone cysts with adequate x-ray coverage chosen from the files of Memorial Center, New York, constitute the material for the present analysis. This is the largest single series studied roentgenologically to date. More than 11 of the cases would be considered "atypical" roentgenologically if judged by existing roentgen criteria. The pathological diagnoses were made by various staff members of the pathology department of Memorial Center, and Dr. Arthur Allen reviewed all cases needing special consideration.

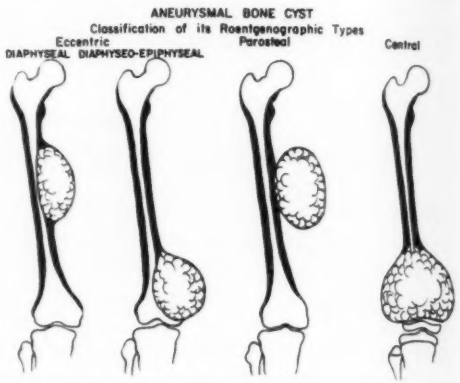

Fig. 1. Roentgen types of aneurysmal bone cyst.

Nineteen patients were males and 24 females. The age distribution was as follows:

Age in Years	No. of Cases
0– 9	6
10–19	21
20–29	8
30 and over	8

The median age was fifteen years, the mean age nineteen. The youngest patient was four, and the oldest sixty-one.

Aneurysmal bone cyst is thought to be non-existent in infancy and rare among young children and older adults, being a disease of adolescence with its highest

[1] From the Department of X-ray Diagnosis, Memorial Center, New York, N. Y. Accepted for publication in May 1956.

incidence between ten and nineteen years. One would suspect, however, that an aneurysmal bone cyst could remain clinically silent for some time and its discovery, therefore, be delayed or even incidental. One such instance seems to have occurred in a man in his sixtieth year, who was found quite by chance to have a characteristically expanding reticulated lesion in a transverse process of the lumbar spine. Unfortunately no attempt was made to obtain histologic confirmation.

The distribution of cysts in the skeleton in this series was as follows:

Long Bones	18	Pelvis	7
Humerus	5	Pubis	4
Femur	4	Ilium	3
Tibia	4	Vertebral Column	6
Radius	3	Lumbar	4
Ulna	1	Thoracic	1
Fibula	1	Sacral	1
Small Tubular Bones	9	Others	3
Clavicle	4	Mandible	1
Metatarsals	2	Os calcis	1
Metacarpals	1	Scapula	1
Phalanges	2		

It is evident that, although practically any bone may be involved, the sites of predilection are the tubular bones, vertebrae, and pelvis.

As might be expected, the symptoms and physical findings offered no clue of real value for differentiation of this lesion from similar disorders. The laboratory findings were equally non-specific. The average duration of symptoms before diagnosis was said to be seven months.

It is of interest to note that in all 6 children under nine years of age the cysts were unusual either in appearance or in location. Three were centrally located in the upper end of the humerus or tibia; one had the appearance of "vertebra plana," and the fifth and sixth were in the os calcis and mandible. These facts suggest that aneurysmal bone cyst occurring in childhood tends to be "atypical" roentgenologically.

Generally speaking, the lesions in the small tubular bones, slender long bones, and proximal end of the humerus tended to be symmetrical and central in location, whereas elsewhere aneurysmal bone cyst tends to be eccentric. Thus the location in the skeleton, as well as the age of the patient, plays an important role in the roentgen appearance.

ROENTGEN APPEARANCE

A. The Tubular Bones

The roentgen types found in the tubular bones were as follows: (Fig. 1)

(1)	Eccentric type		10
	Diaphyseal	6	
	Metaphyseal	4	
(2)	Parosteal type		4
(3)	Central type		13
	Diaphyseal	6	
	Metaphyseal	7	
			27

1. Eccentric Type: The roentgen features displayed by the 10 "classical" lesions were eccentric position, diaphyseal location, ovoid configuration, and an expanding, ballooned-out, rarefied area containing fine and incomplete ridges or septa, producing a honeycomb appearance. The borders were well demarcated, with a thin layer of new bone in continuation with the expanded and thinned cortex. When these findings were present, it seemed that the diagnosis of aneurysmal bone cyst could be made with confidence (Fig. 2).

Location in the shaft of the bone, either at the mid-level or at the metaphyseal area, was such a constant feature that one would consider it to be a prerequisite for diagnosis, because, regardless of roentgen type, all lesions in the tubular bones were to some degree in the diaphysis. Six of the 10 cases of eccentric type were at or near the middle of the shaft and 4 near the end. Consequently, eccentric diaphyseal (Fig. 2) and eccentric metaphyseal subtypes (Fig. 3) were recognized. Following the cessation of endochondral bone growth, the epiphyseal part of the bone may be invaded by direct extension from the diaphyseal part. This seemed to be the situation in 4 lesions of the eccentric metaphyseal type. The epiph-

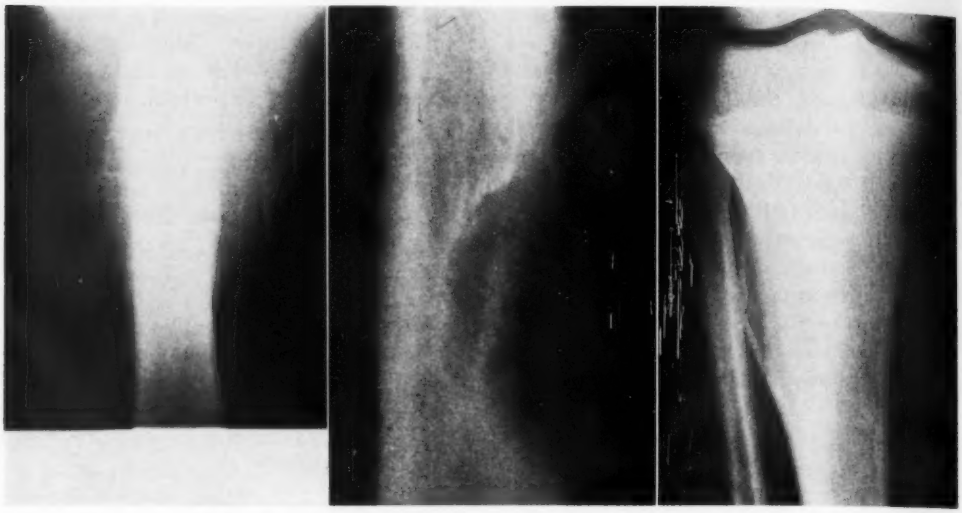

Fig. 2. Aneurysmal bone cysts of eccentric diaphyseal type; 3 cases.

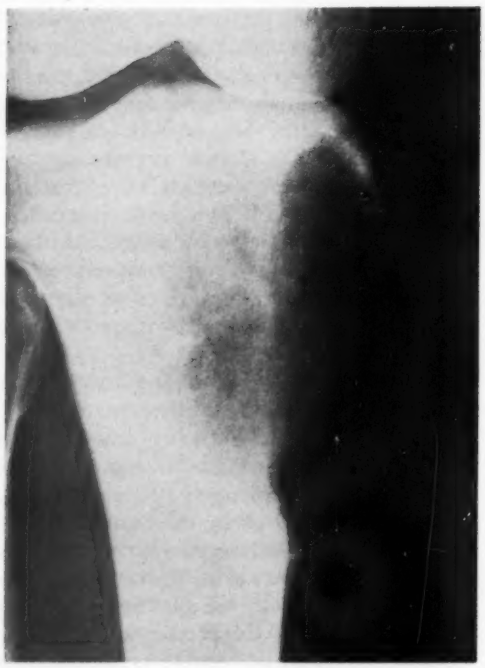

Fig. 3. Eccentric metaphyseal type of aneurysmal bone cyst.

ysis was never affected when the epiphyseal line was present.

The lesion ranged from 4 to 12 cm. in greatest dimension, the average being 8 cm. These dimensions fit, in general, all aneurysmal cysts in this series. With the exception of one cyst that showed a spherical shape, every lesion was ovoid. The greatest dimension always coincided with the long axis of the bone.

As to the site of origin of the cyst, *i.e.*, whether it arose from the cortex, periosteum, or soft parts, it seemed, from the standpoint of the roentgen picture alone, that examples of all three were present. In all, an eccentric position of the lesion was noted. The intraosseous component was almost always smaller than the extraosseous. This was due to expansion of the cyst outside the bone area, producing the striking roentgen appearance.

The lesion has, at least at some points, consistently well demarcated borders, an attribute perhaps of its benign nature. The inner or intraosseous borders were always distinct and smooth, with occasional sclerotic areas. The outer or extraosseous border, consisting of a thin layer of new bone, often had a characteristic "eggshell" appearance. In the early stage it was so delicate that it was barely discernible, becoming denser and thicker with growth of the cyst. The inner or intraosseous border, because of its distinctness,

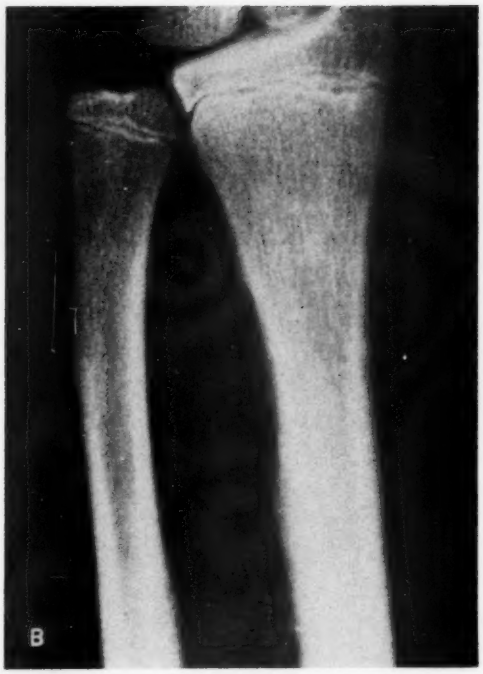

Fig. 4. A and B. Parosteal type of aneurysmal bone cyst: 2 cases.

was of greater diagnostic value in an early stage, while the outer border was indistinct or even appeared to be absent. Once the "eggshell" was formed, however, the outer or extraosseous border was the more characteristic. In spite of bulky extension of the lesion beyond the bone, no significant local soft-tissue reaction was observed outside the "eggshell curtain." The perpendicular type of periosteal reaction was absent, but a minimal, smooth, laminated periosteal elevation with triangular or cuff-like appearance at both ends of the cyst was not unusual.

Except for 2 cysts which failed to show any ridge formation or septa, the internal pattern was quite specific. The ballooned-out lytic process contained fine and incomplete lines forming many small loculations, which were more numerous and smaller at the periphery of the lesion. The loculations seen on the gross specimens were not always discernible on the films. In the late stage and following surgical intervention or irradiation, the ridges became denser and coarser.

2. Parosteal Type: The eccentric position of the parosteal lesions was such that, except for a minimal erosion of the outer cortex, the lesion was seen with almost its entire bulk projecting into the adjacent soft parts. Although the appearance was essentially that of the eccentric type, we believe that the 4 cases classified in this category deserve recognition as a separate type from the point of view of differential diagnosis (Fig. 4A).

Three of the 4 cases were characteristic roentgenologically. In the fourth, however, only saucerized cortical erosion and cuff-like, laminated periosteal elevation were discernible (Fig. 4B). One would surmise that in its early stage the lesion would not usually be recognizable and that one would be tempted to lean toward the diagnosis of a malignant tumor.

3. Central Type: In contrast to the characteristically asymmetrical eccentric and parosteal types, a symmetrically located pear-shaped or fusiform aneurysmal bone cyst expanding the entire width of the bone, with no extension to the soft parts, was encountered. Otherwise the roentgen features were those of the other types. The location was either near the middle of the shaft or at the end. Consequently, as in the eccentric type, two subtypes, namely, central diaphyseal

Fig. 5. Central diaphyseal type of aneurysmal bone cyst.

and central metaphyseal, were recognized. Altogether there were 13 cysts of central type, constituting 48 per cent of the material in long and small tubular bones. Six were central diaphyseal and 7 central metaphyseal. The former usually occurred in the small tubular bones, whereas the latter were usually in the slender long bones, although the larger long bones were also involved.

(*a*) *Central Diaphyseal Type:* All the aneurysmal bone cysts in the metatarsals, metacarpals and phalanges were of the central diaphyseal type. The shaft of the bone was affected almost in its entirety, presenting a symmetrically expanded reticulated structure with occasional cortical erosion. Except for the central position, the roentgen characteristics were like those of the "classical" eccentric type (Fig. 5).

(*b*) *Central Metaphyseal Type:* As noted earlier, there was a significant proportion of material showing an x-ray appearance which previously had not readily been distinguished from the unicameral or juvenile bone cyst. The existence of this form raised the question of the validity of the prevailing concept of the roentgen diagnosis of both aneurysmal and juvenile bone cysts. A search of the literature did reveal a few examples of this type, included in some reports on aneurysmal bone cysts. Of 18 lesions in the large long bones in the present series, 6 were of this central metaphyseal type. Three of these were in the proximal end of the humerus, and the others in the distal end of the radius, the distal end of the fibula, and the proximal end of the tibia, (Fig. 6).

B. The Vertebral Column

The vertebral column is a frequent site of aneurysmal bone cyst. There were 6 such cases in the present series: 4 in the lumbar spine and 1 each in the thoracic spine and sacrum. The neural arch appeared to be the site of predilection, as the laminae were involved in every instance. The lesion, usually eccentric in position, began as an area of rarefaction with little or no internal structure and barely discernible borders. Eventually an expanding multiloculated process was seen extending into the soft parts, with "eggshell" borders (Fig. 7). When the vertebral body was involved, it usually collapsed sooner or later in the course of the disease. Complete collapse occurred in 1 patient, and under the circumstances roentgen diagnosis was impossible.

C. The Pelvis and Other Areas

Of 7 aneurysmal cysts in the pelvic bones, 4 were in the pubic ramus, 2 in the ilium near the acetabulum, and 1 in the iliac wing. In spite of an eccentric position in the early stage, the lesion in the pubic ramus tended to be more or less centrally located, with relatively extensive bone involvement. Consequently,

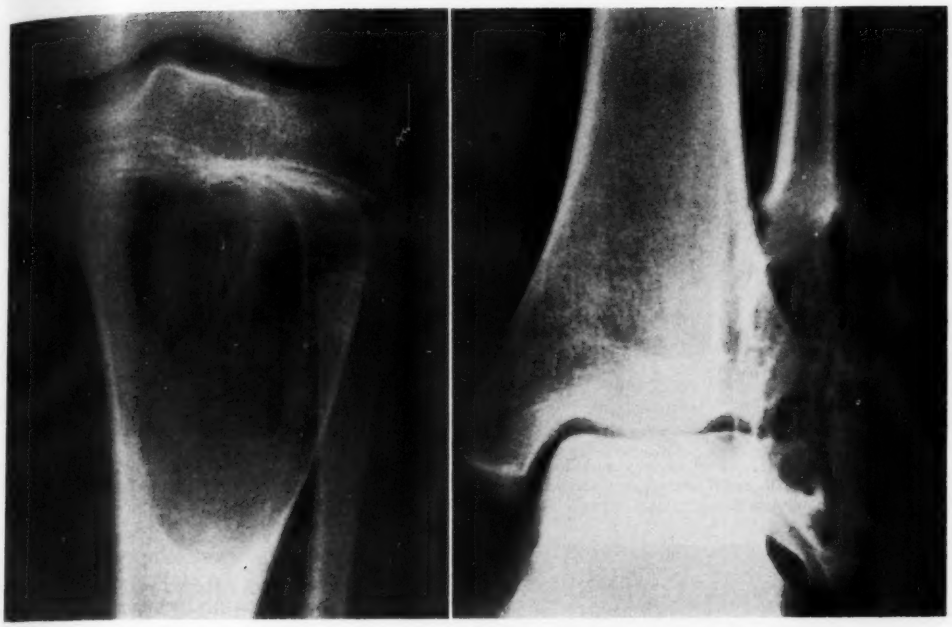

Fig. 6. Central metaphyseal type of aneurysmal bone cyst: 2 cases.

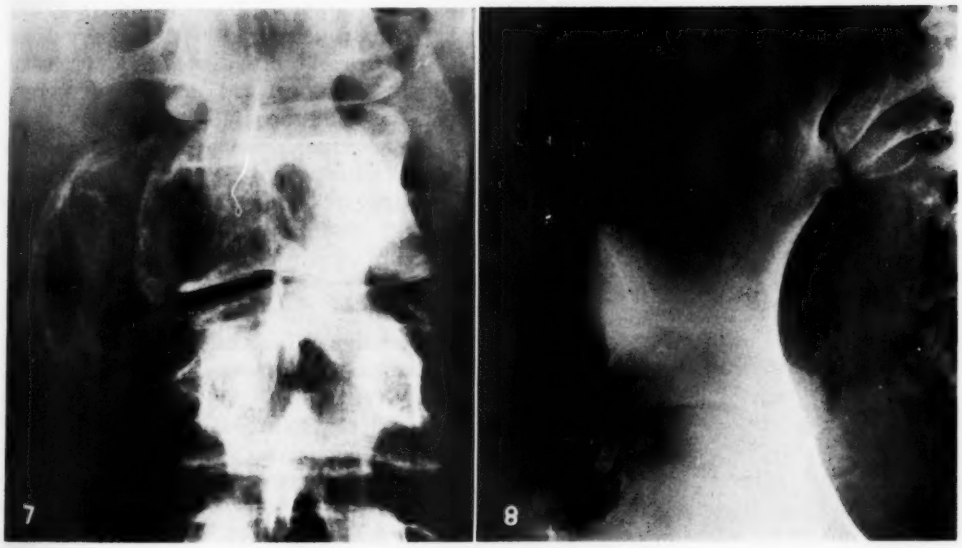

Fig. 7. Aneurysmal bone cyst in the lumbar spine.
Fig. 8. Aneurysmal bone cyst in the pelvis, in an early stage.

the roentgen appearance was basically that described for the central type in the long bones.

The 2 cysts near the acetabulum presented the greatest difficulty diagnostically, as only irregular bone destruction at the brim of the acetabulum was at first discernible. A diagnosis of malignant bone

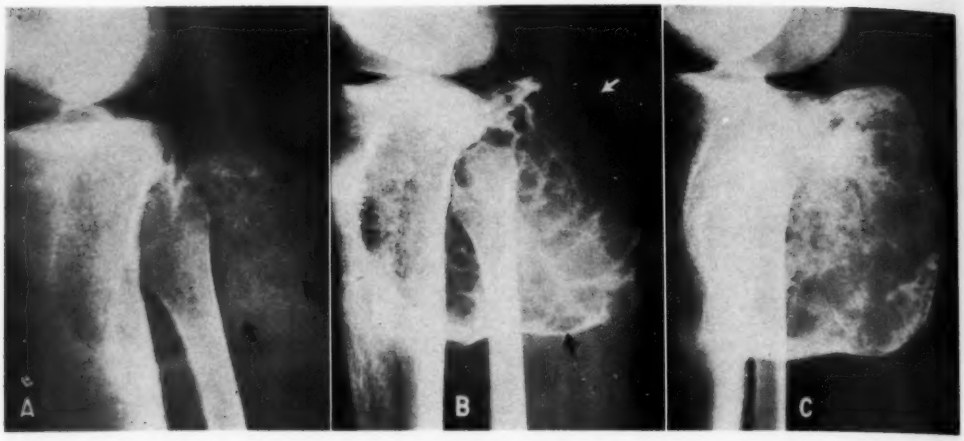

Fig. 9. Natural history of aneurysmal bone cyst. A. Early lytic stage. B. Mature stage. The lesion has grown in spite of curettage. C. Calcified stage. There had been no treatment after the roentgenogram shown in B was obtained.

tumor would usually be offered under these circumstances. Subsequently, a full-blown reticulated ovoid calcified structure appeared (Fig. 8). The cyst in the iliac wing presented as a round area of rarefaction with sclerotic borders, containing faint calcification in addition to incomplete septa.

The lesions in the os calcis, scapula, and mandible had a typical x-ray appearance, with expansion and faintly discernible septations.

NATURAL HISTORY AND EFFECT OF TREATMENT

There were 17 cases in the present series in which x-ray coverage provided observation of the development of the lesion for periods from three months to as long as three years before any treatment was instituted. Speaking generally, there were three stages of development. An early or lytic lesion was superseded by a mature or characteristic appearing cyst, followed finally by a late or calcified stage. The majority of the cases were seen in the mature or full-blown and characteristic stage. The development of the peripheral bone shell and internal septa or ridges in a matter of a few months was observed (Fig. 9). Following the appearance of a full-blown lesion, several events may take place. First, the cyst may continue to grow, at a rate which is quite variable and unpredictable. In one instance the volume increased fourfold in seven months, whereas in another an increase of only 10 per cent was noted in over three years (Fig. 10). As to any relation of growth rate to age and location, the present material did not permit definite conclusions. Second, it would seem that reactivity may develop following a period of latency. In other words, before the appearance of calcification there was always the possibility of reactivation in spite of apparent stability of the lesion. Spontaneous regression or transformation from a full-blown lesion into a calcified and ossified one may occur (19). There were at least 3 such examples in this series (Fig. 11). Once the lesion reached the solidified stage, with appearance of calcification and ossification, there was no instance of recurrence. A favorable response to treatment either by irradiation or curettage was marked by the development of the late calcified stage. The sequence of events (Fig. 12) was as follows:

The borders and the reticulation became more distinct, followed by the appearance of a generalized haziness. Subsequently, there was continued in-

Fig. 10. A. Aneurysmal bone cyst in the metatarsal. In this location the central diaphyseal type is the rule. B. Same case six months later, showing marked increase in the size of the cyst.

crease in the thickness of the peripheral bone shell as well as central ridges or septa, with calcifications, faint at first but later dense, within the lobulations. Unlike some giant-cell tumors, the general contour and overall size remained about the same. In contrast to the surgically treated juvenile bone cyst, complete reossification and return to a normal bone picture was exceptional. Ordinarily, partial reossification and recalcification were the rule. The reparative process took place within a few months to several years and was usually a continuous one. In a few cases there was continued growth in spite of treatment, either by irradiation or curettage. It is also of interest to note that the "paradoxical effect," an increase in bone destruction immediately following x-ray therapy, seen in giant-cell tumor was not found in cases of aneurysmal bone cyst.

As far as we know, there is no instance of malignant degeneration in this series or in the literature. One case has been followed for over thirty years.

Surgical treatment varied from simple curettage to complete resection. Eleven patients undergoing resection had no recurrence. Fourteen patients were treated by curettage and 8 by curettage plus insertion of bone chips. Recurrence developed in 10 instances in this group. In several instances a favorable result followed a second curettage.

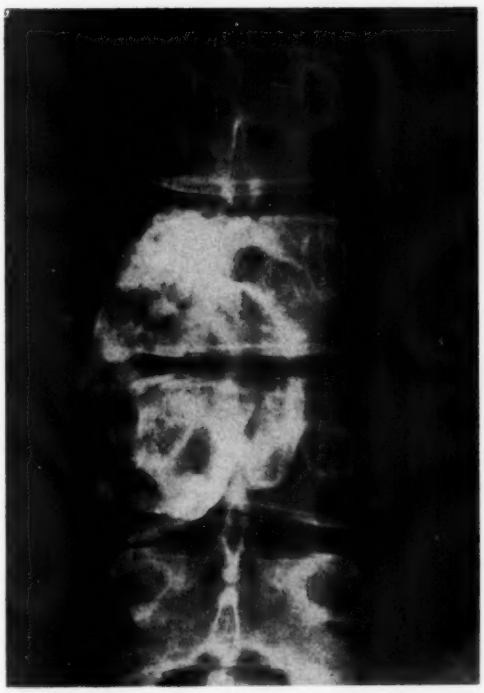

Fig. 11. Spontaneous calcification of an aneurysmal bone cyst, without treatment.

Roentgen therapy was given to 8 patients, with a single failure. The tissue

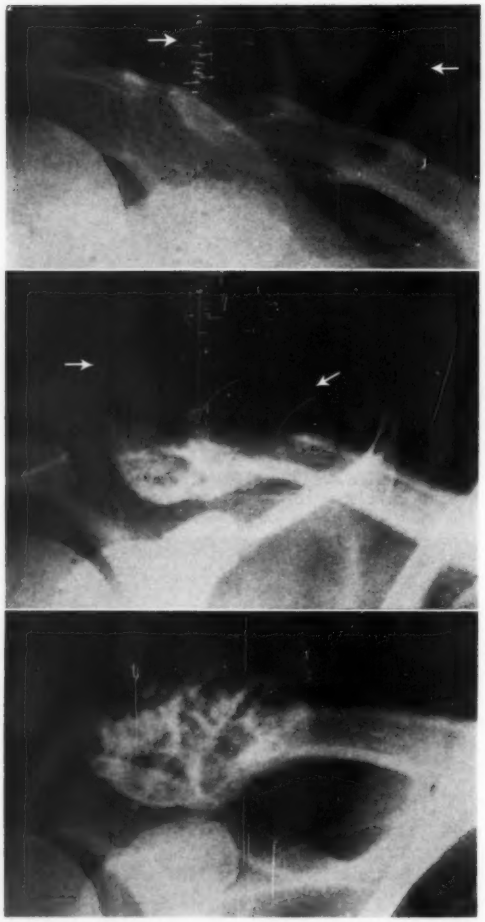

Fig. 12. Three stages in the favorable response of an aneurysmal bone cyst to roentgen therapy.

dose was in the neighborhood of 2,000 r in two weeks (Fig. 12) (3, 5, 10).

DIFFERENTIAL DIAGNOSIS

In the long bones the fully developed "classical" eccentric type seen in this material shows an x-ray appearance not presented by other bone lesions. The characteristic expansion, eccentricity, and internal pattern are such that non-osteogenic fibroma, monostotic fibrous dysplasia, chondroblastoma, and enchondroma can readily be ruled out, these being the diseases considered as most likely to resemble this type of aneurysmal bone cyst.

In view of its close association with the epiphyseal area, giant-cell tumor of bone needs little discussion here. In its early stage, however, aneurysmal bone cyst may present as a purely lytic lesion at the metaphyseal-epiphyseal region in an adult. Under these special circumstances a correct diagnosis is most difficult, if not impossible, and the giant-cell tumor is usually considered first. There was only one such occurrence in the present series. Chondromyxoid fibroma may simulate an aneurysmal bone cyst in its expansion, eccentric location, and reticulated internal pattern. The two lesions probably can be distinguished, however, as it is believed that chondromyxoid fibroma has more scalloped borders and thicker, denser, and more complete and regular septation.

The parosteal roentgen type of aneurysmal bone cyst is quite characteristic and there is little or no trouble with differential diagnosis. We doubt that there can be any real resemblance to the garden variety of myositis ossificans. Following extensive calcification and ossification, the aneurysmal bone cyst may lose its internal structure. At this stage of the disease histological opinion may be unrevealing.

It is in the central symmetrically expanding lesion of the long bones, particularly in the proximal end of the humerus, that most of the difficulty in roentgen diagnosis arises. It is often not possible to differentiate reliably between the unicameral or juvenile bone cyst and aneurysmal bone cyst. As a working basis for differentiation the following diagnostic points are to be considered: It is usual for unicameral bone cyst to occur in the proximal end of the humerus and femur, while the aneurysmal bone cyst shows no similar predilection. There is a lesser degree of bone expansion in the unicameral bone cyst. The finer, more numerous, multiloculated honeycombing seen in the aneurysmal bone cyst occurs infrequently in unicameral bone cyst, as the name implies. The latter has more distinct and

regular contours or borders and no fine scalloping at the margins. In juvenile bone cyst there may be complete reossification and a return to normal appearing bone following surgical treatment, while the aneurysmal bone cyst tends to maintain the same contour and size, presenting less complete reossification. The juvenile bone cyst apparently is not affected by radiation in the usual doses.

If one is aware of the symmetrical and expanding character of the lesion in the small tubular bones of the hands and feet, the diagnosis can usually be made with certainty. On occasion hemangioma of the small bones may bear some resemblance to aneurysmal bone cyst in respect to bone expansion and internal pattern. Ordinarily in hemangioma the septa are complete and the loculations well organized and of equal size and are smaller and more regular.

In the vertebral column there is less difficulty in recognizing this lesion when the neural arch and processes are affected. The typical eccentric, ballooned-out appearance is usually present. On the other hand, when the entire vertebral body is invaded and complete collapse occurs, a specific diagnosis is not possible.

When a flat bone, such as the iliac wing, is the site of the lesion, the usual bone expansion may not be appreciable on the routine films, and stereoscopic studies may then be of aid. Eosinophilic granuloma, plasma-cell myeloma, metastases of thyroid and kidney origin, and primary bone tumors are to be taken into consideration under the circumstances.

As noted earlier, regardless of the roentgen type, the lesion under discussion presents the greatest diagnostic problem when seen in its early stage. Some confusion with malignant bone tumors, especially periosteal fibrosarcoma, seems inevitable at times. Special care should be exercised to identify the usual smooth, distinct intraosseous boundary of the lesion even though the outer or extraosseous boundary may appear disrupted or absent.

SUMMARY AND CONCLUSIONS

1. Forty-three histologically proved aneurysmal bone cysts have been studied roentgenologically.

2. Aneurysmal bone cysts present a varied roentgen appearance.

3. The roentgen findings are influenced by the bone involved, the site of involvement, the age of the patient, the duration of the disease and the effect of treatment.

4. A classification of the roentgen types occurring in tubular bones is offered.

5. The uncommon roentgen forms of aneurysmal bone cyst are emphasized.

6. Differential diagnosis has been briefly considered, roentgenologically.

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SUMMARIO IN INTERLINGUA

Cyste Aneurysmatic de Osso: Su Diagnose Roentgenographic

Quaranta-tres casos de cyste aneurysmatic de osso esseva studiate roentgenographicamente. Esseva constatate que le roentgenogrammas variava con le osso implicate, le sito del lesion, le etate del patiente, le duration del morbo, e le responsa al therapia.

Tres principal typos roentgenologic esseva recognoscite in le ossos tubular: eccentric, parosteal, e central. Le typos eccentric e central esseva sub-dividite como diaphysal e metaphysal. Lesiones vertebral esseva usualmente de location eccentric e afficeva le arco neural. Quanto al cystes locate in altere ossos, illos proxime al acetabulo offereva le plus grande difficultates diagnostic in tanto que illos exhibiva solmente formas irregular de destruction de osso.

Esseva notate tres stadios de disveloppamento: (1) Un stadio precoce o lytic; (2) le stadio del cyste matur a apparentia characteristic; e (3) un stadio calcificate.

Cystes matur de disveloppamento complete es characterisate per le presentia de un peripheric concha de osso con septos e crestas interne. Le rapiditate del crescentia es variabile.

Le difficultates del diagnose differential es le plus marcate in le caso de cystes central a expansion symmetric in le ossos longe. Sin reguardo al typo roentgenographic, lesiones precoce presenta le plus grande problemas diagnostic.

Vertebral Changes in Childhood Leukemia[1]

BERNARD S. EPSTEIN, M.D.

THE OSSEOUS changes produced by leukemia in children have long been recognized, the acute lymphatic form being the chief offender. Best known are the radiolucent transverse bands at the diaphyseal ends of the long bones, ascribed primarily to pressure effects of proliferating packed leukemic cells on actively growing bone. Other structural changes include focal destruction of cancellous and cortical bone, perforations of bone cortex, periosteal elevation, subperiosteal bone formation, diffuse osteoporosis, and occasionally osteosclerosis (1, 8). Extensive leukemic deposits may be present in the bone marrow with no visible effect. While in some cases osseous involvement may produce no discomfort, in others there may be pain which is readily confused with rheumatic symptoms.

Spinal involvement in leukemia has not received as much attention as the better recognized changes in the extremities.

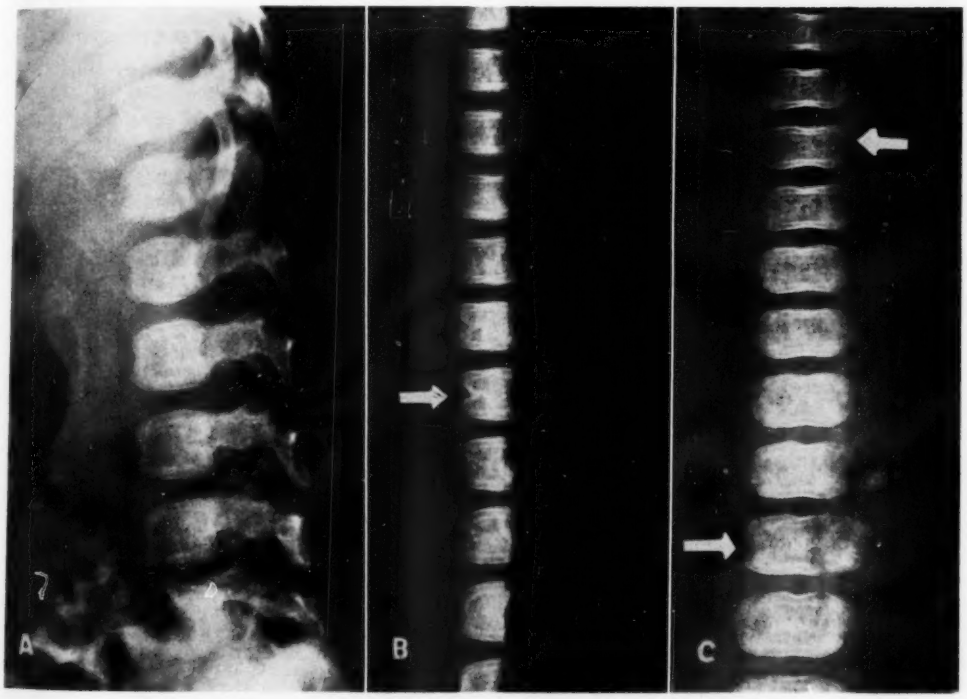

Fig. 1. R. P., an eight-month-old male infant with acute lymphatic leukemia. A. Lateral roentgenogram showing diffuse demineralization of the spine, more prominent in the centers of the vertebrae. Radiolucent bands are present at the superior and inferior aspects of the vertebrae.

B. Lateral roentgenogram of specimen strip of spine from the fifth thoracic to the fifth lumbar vertebrae. The zones of rarefaction at the upper and lower aspects of the vertebrae are clearly outlined. Note the indentations at the anterior venous grooves from the tenth thoracic (arrow) to the second lumbar vertebra.

C. Anteroposterior roentgenogram of the same spine strip. The cortex of the lateral aspects of several of the vertebrae in the midthoracic and upper lumbar segments is thinned (arrows).

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[1] From the Department of Radiology, The Long Island Jewish Hospital, New Hyde Park, N. Y. Accepted for publication in May 1956.

Fig. 2. J. H., a three-year-old girl with acute lymphatic leukemia. Lateral spine roentgenogram revealing diffuse demineralization with radiolucent bands superiorly and inferiorly from the twelfth thoracic to the fourth lumbar segment (arrows). The ninth thoracic vertebra is wedged (bracket) and the anterior venous sinus is prominent.

Vertebral osteoporosis, compressional deformities, and occasional instances of bone destruction have been recorded (3). The present report describes the radiologic changes in the spines of 15 children with leukemia, varying in age from six months to fourteen years, including 5 mentioned previously (5). Of these children, 1 was six months old and another was seventeen months; 6 were between two and six years of age, and 7 were between seven and fourteen years. The group was about evenly divided between males and females. The known duration of the disease ranged from about ten weeks to well over two years. Acute lymphatic leukemia was diagnosed in 9 cases. In 1 the diagnosis was acute myeloblastic leukemia, while in the others no specific cell type was established. In all instances, characteristic roentgenographic changes were noted in the extremities. Necropsy observations were made in 7 cases.

The radiographic changes noted in the vertebrae included diffuse demineralization of the bodies, the neural arches, and the transverse processes. The loss of bone density appeared to be more pronounced in the thoracic and the upper lumbar spine. In 6 of the children, this demineralization was greater in the centers of the vertebrae than at their peripheries. Varying degrees of compression of the

Fig. 3. Specimen strip of spine from case shown in Fig. 2. Note the vacant space under "1" between the first and third lumbar vertebra. When this specimen was cut, the cancellous vertebral core was popped out with gentle pressure.

The numerals 2, 3, and 4 designate lower thoracic vertebrae showing similar changes, with focal areas of radiolucency at sites of disappearance of cancellous bone. These were marked for correlation with microscopic examination, which revealed extensive replacement of the marrow with leukemic cells, including the peripheries of the vertebrae.

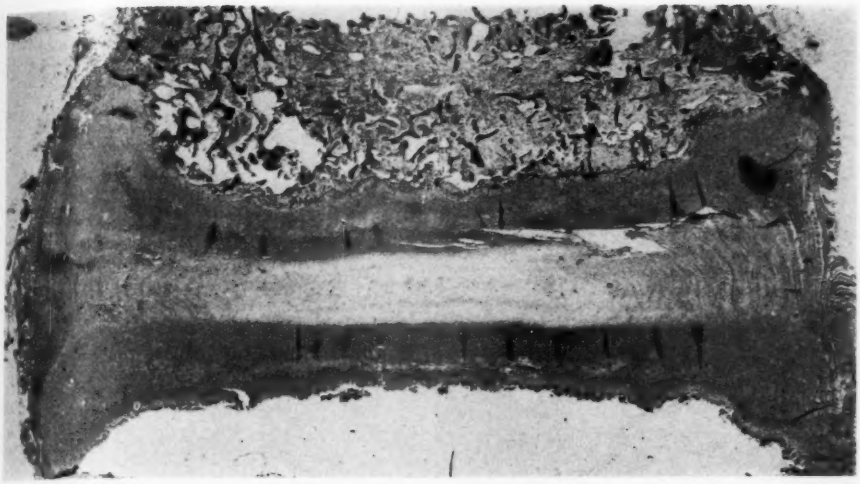

Fig. 4. Photomicrograph of specimen shown in Fig. 3, under "1." The infiltration with leukemic cells extends into the growing margins of the vertebral bodies. There is disruption of the orderly arrangement of the cancellous bone beneath, and the marrow space is packed full of leukemic cells.

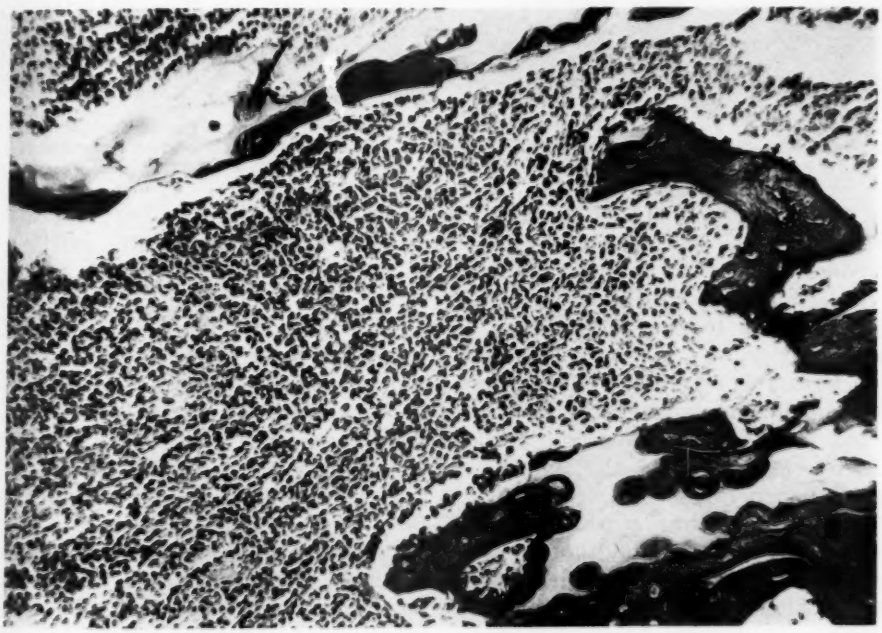

Fig. 5. High-power field of same specimen as reproduced in Fig. 4, showing leukemic infiltration and disruption of cancellous bone.

vertebral bodies were observed, the most common structural change being anterior wedging. In some infants the anterior venous sinuses in the middle and lower thoracic vertebrae were widened. Thinning and breaking of the cortical margins were occasionally seen, but these features were better demonstrated on postmortem roentgenograms of vertebral slabs.

Of particular interest were horizontal

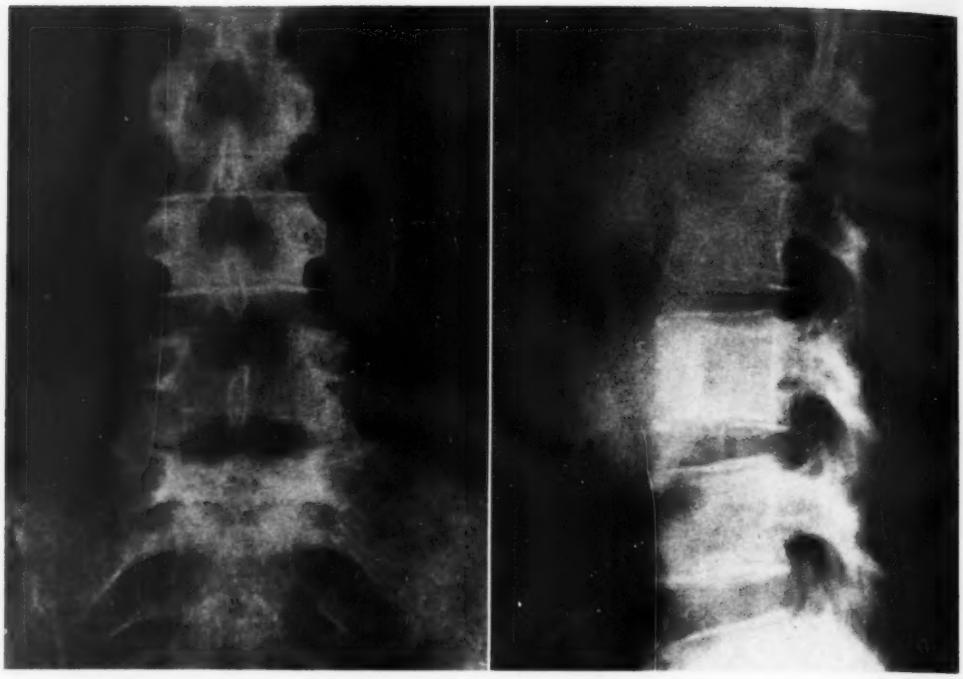

Fig. 6. Anteroposterior and lateral lumbar spine roentgenograms of a thirteen-year-old patient with acute leukomyelosarcoma diagnosed at necropsy in 1933. The radiolucent bands at the upper and lower aspects of the vertebrae are prominent. (From Epstein, B. S.: The Spine, Philadelphia, Lea & Febiger, 1955).

zones of radiolucency at the upper and lower aspects of the vertebral bodies, corresponding to similar zones at the ends of the long bones. This is considered to be analogous to the disturbances of endochondral growth in the extremities, inasmuch as the vertebral epiphyses are at the cephalic and caudal aspects (2).

In the 7 cases in which necropsy confirmation was available, the extent of vertebral demineralization was found to vary considerably, but appeared to be more pronounced in the midthoracic and the thoracolumbar areas. Roentgenograms of slabs of spine removed at necropsy were made in 4 cases, disclosing many small focal areas of loss of cancellous bone. Histologic studies showed thinning of the bony trabeculae to the point of disappearance in scattered areas. The orderly arrangement of trabeculae was disturbed, with leukemic cells packed between them. The horizontal zones of radiolucency were ascribed to disruption of the normal chondro-osseous junctions by proliferating leukemic cells. In 1 instance, this weakening was so pronounced that it was possible to eject the core of cancellous bone from the surrounding cortex by simply pushing against the centrum (Fig. 3). A search for osteoclasts along the trabeculae failed to disclose any significant number of these cells.

It is known that cortical steroid and folic acid antagonist therapy may produce recession of the bony changes concomitant with the clinical remissions (4, 7). In our series, the cases treated in this manner were seen either terminally or during the acute phases, so that we have nothing definite to add in this connection, with regard to the spine.

SUMMARY

Diffuse leukemic infiltration of the vertebrae in children produces demineraliza-

tion of bone and compressional deformities. Another effect which may be seen on roentgenographic examination is the occurrence of horizontal radiolucent zones at the upper and lower margins of the involved vertebrae. These are considered to be analogous to similar zones at the growing margins of the long bones.

ACKNOWLEDGMENT: The pathological material was reviewed by Dr. James Berkman and Dr. Yin-Chen Lee, Department of Pathology of the Long Island Jewish Hospital, and Dr. David Grayzel, Department of Pathology of the Jewish Hospital of Brooklyn. The author expresses his thanks to them and to the Jewish Hospital of Brooklyn for permission to use material observed while he was a member of the staff.

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SUMMARIO IN INTERLINGUA

Alterationes Vertebral in Leucemia de Infantia

Le autor describe le alterationes radiologic observate in le spina dorsal de 15 infantes leucemic de etates de inter sex menses e dece-quatro annos. Le alterationes notate includeva le diffuse dismineralisation del corpores vertebral, del arcos neural, e del processos transverse, con deformitates de compression. Particularmente interesante esseva zonas horizontal de radiolucentia al aspectos superior e inferior del corpores vertebral, correspondente a simile zonas al extremitates del ossos longe. Iste zonas esseva ascribite a un disruption prominente del normal junctiones chondro-ossee per le proliferation de cellulas leucemic.

Unusual Bilateral Sacrococcygeal Ossicles[1]

WILLIAM S. CORNWELL and GEORGE H. RAMSEY, M.D.

TWO WELL DEFINED bones in the region usually occupied by the lateral sacrococcygeal ligaments or their ossified remnants may well be unique both as radiographic findings and as anatomic entities. This rare condition (Fig. 1) was discovered subsequent to a radiologic examination requested because of obvious abnormalities.

The patient was a white man, 38 years old, who earned his living as a machinist. He had presented himself for an eye examination because of refractive defects and for possible relief of rhinalgia that had been present as long as he could remember. Under the circumstances, only a meager history was obtained, but even a superficial physical examination disclosed such peculiarities as marked depression of the nasal root, broadness of the cranium, anodontia, and coxa valga. For that reason an x-ray examination was made of all bony structures. The clinical impression of dysostosis was borne out by the x-ray findings, the most important of which were as follows: virtual absence of the nasal bones; patency of the metopic suture; a huge defect involving the coronal suture; wide separation of the parietal and occipital bones all along the lambdoid suture; excessive formation of wormian bones, also along the lambdoid suture; abnormal arrangement of the nasal accessory sinuses; basilar impression; shortening and recurving of the middle phalanges of the fifth digits of the hands.

The sacrum was comprised of six vertebral segments, the first being formed by an almost completely sacralized last lumbar vertebra. The enlarged transverse processes of this vertebra appeared to form accessory articulations with the lateral superior surface of the vertebra next below. Posteriorly, the neural arches of the third and fourth sacral vertebrae were not completely fused in the mid-line. The first coccygeal vertebra was a distinct element with easily identified transverse processes and coccygeal cornua.

The two ossicles were slender elements located on either side of the sacrococcygeal articulation. Each articulated superiorly with the corresponding lateral angle of the last sacral vertebra and inferiorly with the distal end of the first coccygeal transverse process. As shown in the radiograph (Fig. 1), and in the artist's reconstruction (Fig. 2), they appeared irregularly cylindrical, with flattened ends. The medial border of the left ossicle was much shorter than the lateral border because of the oblique angle of its articulation with the coccygeal transverse process. The images of the small joints at both ends of the bones were distinct and there was no evidence of fusion with the sacrum or the coccyx.

DISCUSSION

When the images of the two ossicles were first observed, it was assumed that they might be ossified lateral sacrococcygeal ligaments. It was soon recognized, however, that if so they must be of an unusual type. Normal ossification of a lateral sacrococcygeal ligament appears to begin at either the lateral angle of the last sacral vertebra or the first coccygeal transverse process, or both. When ossification is completed, a bar of bone is formed that encloses the foramen for the fifth sacral nerve. While the formation of joints with the sacrum or coccyx does not seem to have been reported, the possibility should not be entirely dismissed. As is well known, this does occur elsewhere in the human body, notably in the stylohyoid ligaments.

In the example described, the coccyx showed no tendency to fuse with the sacrum. Unfortunately, neither a lateral ra-

[1] From the Department of Radiology, The University of Rochester School of Medicine and Dentistry, Rochester, N. Y. Accepted for publication in March 1956.

Fig. 1 Portion of anteroposterior radiograph of pelvis, showing ossicles between lateral angle of last sacral vertebra and first coccygeal transverse process on each side of sacrococcygeal articulation.

diograph nor a physical examination was made to indicate precisely the anteroposterior orientation or the degree of mobility of the coccyx. However, it is quite possible that the coccyx was not only freely movable but that it was subject to an excessive amount of movement, the latter a consequence of abnormal posture. The basis for this theory is the radiograph of the pelvis and upper portions of the femurs reproduced as Figure 3. The coxa valga and the unusual separation of the sacroiliac articulations, indicative of unusual mobility of these joints, are well shown. As a result, when the lateral sacrococcygeal ligaments ossified, the degree of coccygeal mobility perhaps was such as to induce joint formation and to prevent fusion of the extremities of the ossicles with the sacrum and coccyx.

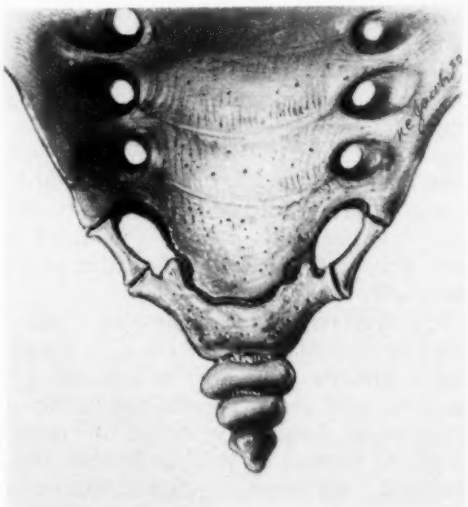

Fig. 2. Artist's reconstruction of sacrococcygeal ossicles shown in Figure 1.

The only other explanation would seem

Fig. 3. Anteroposterior radiograph of pelvis, a portion of which was reproduced as Fig. 1, demonstrating coxa valga and unusual separation of the sacroiliac articulation.

to be that the two ossicles were coccygeal ribs that inclined cephalad and articulated distally with the sacrum. The radiograph, of course, indicated nothing about the lateral sacrococcygeal ligaments as such, but it might be that in the formative stage the rib elements were enfolded or enmeshed in the ligaments and were forced to develop in the direction indicated by the ligaments.

Irnberger (1938) has reported one presumed example of coccygeal ribs in man. The structures interpreted as ribs were bilateral prolongations of the first coccygeal transverse processes but without joint formation proximally. The free distal ends were inclined somewhat in a cranial direction. Irnberger felt that the lateral sacrococcygeal ligaments might be involved in some way in the cranial orientation of his specimen.

The occurrence of coccygeal ribs, either fused or articulated with the first coccygeal transverse processes, is a reasonable concept, as it would parallel the fusion or articulation frequently noted in radiographs of human cervical or lumbar ribs. Obviously, the anomaly is rare, because in the extensive writings on the subject of the human sacrum and coccyx by Le Double (1912), Dieulafé (1933), and Favaro (1934) there is no mention of coccygeal rib formation. Coccygeal chevron bones (hemal processes) in man have been reported by Schultz (1941) and others but, as Gadow (1933) clearly points out, these are different from ribs.

SUMMARY

Two ossicles have been described, one on either side of the sacrococcygeal articulation, in a male patient having some form of dysostosis. Each of these small approximately cylindrical bones articulated superiorly with the corresponding lateral angle of the last sacral vertebra and inferiorly with the transverse process of the first coccygeal vertebra. The possibilities of interpreting these two bones as unusual examples of ossified sacrococcygeal ligaments or of human coccygeal ribs are discussed.

ACKNOWLEDGMENT: The authors wish to express their appreciation to Roger A. Harvey, M.D., Professor of Radiology, University of Illinois College of Medicine, Chicago, for the opportunity of presenting the material described in this article. Acknowledgment is also made to E. Carl Sensenig, Ph.D., Associate Professor of Anatomy, Medical College of Alabama, Birmingham, Ala., and to Miss Cecelia Connorton for their helpful review of the manuscript.

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SUMMARIO IN INTERLINGUA

Inusual Bilatere Ossiculos Sacrococcygee

Iste reporto describe 2 ossiculos trovate un a cata latere del articulation sacrococcygee de un patiente mascule qui sufreva de alicun forma de dysostosis. Ambe iste parve approximativemente cylindric ossos esseva in articulation superiormente con le correspondente angulo lateral del ultime vertebra sacral e inferiormente con le processo transverse del prime vertebra coccygee.

Es discutite le possibilitate de interpretar iste duo ossos como exemplos inusual de ossificate ligamentos sacrococcygee o de human costas coccygee.

Carcinoma of the Cervix Uteri: Ten-Year Study with Comparison of Results of Irradiation and Radical Surgery[1]

RALPH S. CLAYTON, Sr., M.D.[2]

THIS PAPER reports a study of invasive carcinoma of the uterine cervix as seen at Parkland Memorial Hospital, Dallas, Texas, during the ten-year period 1944–1953, inclusive. The purposes of the investigation were: (*a*) to compare results of treatment of carcinoma of the cervix in this hospital with those obtained elsewhere; (*b*) to compare the results of surgery and irradiation at this hospital; (*c*) to determine the effectiveness of radiation therapy in the past, preliminary to evaluation of a new method of radium treatment.

The number of patients was 231 but, since 6 received both surgical and irradiation therapy, the two treated groups total 237. The diagnosis was established histologically in every instance and staging was agreed upon at joint conferences between the Radiology and Gynecology Services. Treatment was planned co-operatively by both services. Radiation therapy was given by the Radiology Service, surgical treatment by the Gynecology Service. The patients were followed by both services in a monthly tumor clinic, and each maintained its own follow-up records.

RADIATION TREATMENT GROUP

Of 200 patients receiving radiation therapy, 76 were white and 124 were Negroes. Epidermoid carcinoma was found to be present in 194 cases, adenocarcinoma in 6. The age distribution is shown in Table I.

One hundred ninety-one patients received their initial irradiation in this hospital. Seven of these had carcinoma of the cervical stump, but are not listed separately. The clinical stages were as follows: Stage I, 24 cases; Stage II, 29; Stage III, 75; Stage IV, 63.

TABLE I: CARCINOMA OF THE CERVIX: AGE DISTRIBUTION IN CASES STUDIED BETWEEN 1944–1953*

Age	Irradiated	Operated
20–29	7	4
30–39	34	13
40–49	71	12
50–59	56	7
60–69	21	1
70–79	8	0
80–89	3	0
	200	37

* In 6 cases, both surgery and irradiation were performed. Net total 231 patients.

Various combinations of external and transvaginal roentgen irradiation and intracavitary and interstitial radium were employed. Not all methods were used in any one case. During the ten-year period of the study the Radiology Service was directed consecutively by four radiologists, and details of treatment therefore varied rather widely. For this reason, it was not possible to correlate results with the exact plan of therapy. All patients in whom recurrences developed after initial irradiation at this hospital, regardless of the dose received, were classified as irradiation failures.

Nine patients were irradiated for recurrent cancer and were classified under that heading. Six of these had received initial radiotherapy elsewhere, and 3 had undergone surgery elsewhere.

Irradiation Mortality and Morbidity: There were no deaths attributable to irradiation. Morbidity data for both patients treated initially in this hospital and those treated for recurrence are given in Table II.

In 163 patients, or 81.5 per cent, there was no significant morbidity. In 29 cases, or 14.5 per cent, morbidity was moderate, the patients showing more than the usual reaction to irradiation, but without requiring surgery or prolonged therapy for

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TABLE II: IRRADIATION MORBIDITY

Stage	Morbidity Group*	1944–1948	1949–1953	Morbidity Group Totals A	B	C
			Irradiated as Primary Treatment: 191 Patients			
I	A	15	5	20		
	B	1	3		4	
	C	0	0			0
II	A	13	10	23		
	B	2	2		4	
	C	0	2			2
III	A	37	23	60		
	B	2	9		11	
	C	3	1			4
IV	A	32	20	52		
	B	4	6		10	
	C	1	0			1
	Totals	110	81	155(81.1%)	29(15.2%)	7
			Irradiated for Recurrent Cancer: 9 Patients			
	A			8		
	B				0	
	C					1
			Total Morbidity: 200 Patients			
	A			163 (81.5%)		
	B				29 (14.5%)	
	C					8 (4.0%)

*A. No morbidity. B. Moderate morbidity. C. Severe morbidity or complications. Major complications: Surgery for lost radium needle, 1; colostomy for rectal stricture, 1; rectovaginal fistulae, 2; vesicovaginal fistulae, 2; intestinal obstruction, 1; skin ulceration, x-ray port, 1. Total, 8.

the complication. Four of this group had proctitis followed by rectal stenosis; 25 had transient cystitis, proctitis, skin, or systemic symptoms. Eight patients, or 4 per cent, experienced severe morbidity. In 1 surgical removal of an interstitial radium needle was required; 1 underwent a colostomy for rectal stricture resulting from irradiation; in 4 patients fistulae developed (2 rectovaginal and 2 vesicovaginal); in 1 an intestinal obstruction was regarded as a possible result of irradiation-induced adhesions, and 1 had prolonged skin ulceration at the site of an x-ray treatment portal.

The absence of mortality and the low morbidity attending irradiation therapy in this series is striking when one considers that 71.8 per cent of the patients had carcinoma of Stages III and IV. The expected mortality from irradiation has been reported as about 1 per cent, but this figure is based largely on series treated before the discovery of antibiotics and modern supportive therapy.

Five-Year Survivals: Table III shows the five-year results, by stages, for the 110 patients treated initially during the first five years of this study. Six patients lost to follow-up were considered to have died of cancer. Of 6 patients treated for recurrent cancer after initial treatment elsewhere, 1 survived five years. Twenty-nine of the 110 patients, or 26.4 per cent, were alive after five years. No patient in whom recurrence developed after initial irradiation at this hospital was subsequently cured by surgery.

TABLE III: FIVE YEAR SURVIVAL IN PATIENTS TREATED PRIMARILY BY IRRADIATION

Stage	Patients	Living
I	16(14.6%)	13(81.2%)
II	15(13.6%)	6(40.0%)
III	42(38.2%)	8(18.6%)
IV	37(33.6%)	2(5.4%)
	110(100%)	29(26.4%)

Hospital Stay: The total hospitalization period for the 200 irradiated cases, including diagnostic work-up and radium therapy, was 4,445 days, an average of 22.2 days per patient. Many of the Stage

IV patients were in a terminal phase, a few being hospitalized for as long as four months, which unfavorably weights the average stay. An average of less than half a day per patient was required for the treatment of complications due to irradiation.

The results of irradiation therapy by stages are comparable to those reported from other centers (1). The relatively low overall cure rate is due to the high percentage of Stage III and IV cases.

SURGICAL TREATMENT GROUP

The surgically treated group numbered 37 patients, including those in whom operation was done initially and those operated upon for proved or for suspected recurrence. Epidermoid carcinoma was present in 34 cases, adenocarcinoma in 3. The age distribution is shown in Table I.

Pelvic Exenteration: Of the 37 patients, 2 underwent pelvic exenteration for cancer recurrent after initial irradiation. One of these died postoperatively, the other lived four years, with death apparently due to hepatic metastases.

Hysterectomy and Pelvic Lymphadenectomy: Thirty-five patients were treated by radical hysterectomy and pelvic lymphadenectomy. In 25 of these, operation was the initial treatment; 4 were operated upon for persistent or recurrent cancer after irradiation; in 4 surgery followed irradiation too soon to permit evaluation of the effects of the radiotherapy. One patient was operated upon for clinical evidence of recurrence only, and in 1 case pelvic lymphadenectomy was performed after invasive carcinoma was discovered in a hysterectomy specimen. The surgical specimens from these last 2 cases showed no cancer.

Surgical Mortality: One of the 2 patients subjected to pelvic exenteration died postoperatively. Among the 35 patients undergoing hysterectomy and pelvic lymphadenectomy, 3 postoperative deaths occurred after the primary operation, and 1 death followed bladder suspension made necessary by the initial radical pelvic operation. The causes of death in these 4 instances were: (*a*) postoperative hemorrhage; (*b*) vesicovaginal fistula, pelvic cellulitis, intestinal ileus, and extracellular fluid deficit; (*c*) paralysis of the leg from cautery, pelvic abscess, exsanguination through abscess sinus; (*d*) paralysis and gangrene of a leg (following bladder suspension).

The operative death rate for the entire group was 13.5 per cent (5 of 37 patients). For the 35 patients undergoing hysterectomy and pelvic lymphadenectomy, the figure was 8.5 per cent from the primary operation, or 11.5 per cent if the death following bladder suspension be included.

Surgical Morbidity: Transient bladder difficulties or pyelonephritis, minor wound infections, and non-fatal hemorrhage or reversible shock during or after operation are not considered as morbidity. These difficulties are to be expected with such extensive surgery.

In 13 of the 32 patients surviving hysterectomy and pelvic lymphadenectomy major complications developed, as shown in Table IV. Because some patients had multiple complications, the number of separate complications exceeds the number of patients.

The combined death and major morbidity incidence in the hysterectomy and pelvic lymphadenectomy group is 45.7 per cent (17 of 35 patients). One patient who suffered a major complication (irreversible urinary incontinence requiring bladder suspension) is also counted as a death after bladder suspension.

Five-year survival cannot be determined in this group, since the operations were performed during the years 1946–1953, inclusive. It is of note, however, that all cases in which the operative specimen showed the spread of cancer beyond the cervix terminated fatally before the preparation of this report in 1955.

Operative Specimen Findings: Cancer was found in both surgical specimens obtained in pelvic exenteration.

No evidence of cancer was found in the operative specimens from 13 (37 per cent)

TABLE IV: SURGICAL RESULTS. COMBINED DATA

	Hysterectomy-lymphadenectomy: 35 patients			Exenteration: 2 Patients	Totals
	Primary Treatment	Proved Recurrence	Clinical Recurrence After Irradiation		
Morbidity and Mortality					
No morbidity	16	2	1	1	20(54.1%)
Surgical death					
Primary	2		1	1	4 11.1%
For complications	1				1 2.4%
Total deaths	3	0	1		5(13.5%)
Major morbidity	7	2	3	0	12(32.4%)
Totals	26	4	5	2	37(100%)
Operative Specimen Findings					
No tumor found	8	1	4	0	13(35.0%)
Tumor cervix only	16	2	0	0	18(48.7%)
Tumor beyond cervix	2	1	1	2	6(16.3%)
Totals	26	4	5	2	37(100%)
Follow-up (32 patients surviving)					
Living (less than 5 years)	17*	2	2	0	21*(65.6%)
Dead of cancer	3	1	2	1	7(21.8%)
Lost to follow-up	3	1	0	0	4(12.6%)
Totals	23	4	4	1	32(100%)

Average Hospital Stay
For initial operation 36.5 days per patient
For complications 11.0 days per patient
Total 47.5

Major complications; Vesicovaginal fistulae, 5 cases; ureterovaginal fistulae, 2; pelvic cellulitis-abscess, 2; neurological bladder incontinence, 4; wound hematoma-abscess, 1; wound evisceration, 1; incisional hernia, 1; fecal incontinence, 1; hemiplegia, 1. Total 18.

* One patient living after radium therapy for recurrence.

of the patients undergoing hysterectomy and pelvic lymphadenectomy. Of the 13, 5 had received irradiation. Three of this latter number had been irradiated immediately before surgery; 1 was operated upon for only clinical evidence of recurrence, and 1 with a histologically proved recurrence apparently was "cured" by the biopsy.

It appears, then, that these 13 patients in whom the operative specimen was free of cancer were cured by irradiation or by biopsy. Major surgery seems to have been unnecessary in this group; nevertheless, 2 deaths from cancer and 2 postoperative deaths occurred. The other 9 patients are either known to be living or are lost to follow-up. For purposes of this report, all surgical patients lost to follow-up are considered to be alive, since to regard the 3 patients in this category as dead would affect the surgical failure rate more than the survival rate.

The surgical specimen was positive for cancer in the remaining 24 cases. Three operative deaths and 4 deaths from cancer occurred in this group. One patient, in whom recurrence developed in the vaginal cuff, was alive and well two years after radium treatment. This patient represents, therefore, a surgical failure and, if she lives five years, should be counted as an irradiation cure.

To summarize: among the 37 patients undergoing exenteration or hysterectomy and lymphadenectomy, there were 8 recurrences and 5 postoperative deaths, or a total of 13 deaths from all causes less than two years after the last operation.

Hospital Stay: The total hospital stay for the 37 patients undergoing surgery was 1,278 days, an average of 36.5 days per patient. Additional hospitalization of 381 days was required for treatment of operative complications, an average of eleven days per patient. The total average stay per surgical patient was thus 47.5 days, or more than twice the length

of hospitalization in the irradiated group.

DISCUSSION

The results reported above for irradiation in carcinoma of the cervix compare favorably with those recorded in the latest *Annual Report* from Stockholm (1). Cure rates by clinical stages are comparable, there was no mortality due to treatment, and the complication rate seems acceptable.

By comparison, results obtained by surgery in this series are unfavorable. No patient in whom the operative specimen showed spread of cancer beyond the cervix proper survived. The mortality was too high, as was the incidence of operative complications. The fact that hospital stay per patient in the surgical group was twice that in the irradiated group indicates that surgery is much more expensive for the patient, while the high proportion of operative specimens showing no cancer suggests that operation is often unnecessarily performed.

Failure to find tumor in the operative specimen may be due (*a*) to its destruction by preoperative irradiation, (*b*) its complete removal at biopsy, or (*c*) inadequate histologic examination with the non-serial section technics commonly employed.

The overall five-year cure rate of 26 per cent for the irradiated group is far from satisfactory. The causes of failure of irradiation are well known: (*a*) insufficient dosage to the periphery of the pelvis; (*b*) limitations imposed by the bladder, rectum, small intestine, and abdominal wall, which are unavoidably irradiated with present technics; (*c*) nonuniformity of dose within a given patient; (*d*) dose restrictions imposed by the large volume of tissue treated by current methods; (*e*) ignorance of the actual extent of the disease; (*f*) radiation-resistance of the cancer.

It appears logical to attack the problem by utilizing the best features of surgery *and* irradiation. Simply, this would involve surgical removal of the uterus and adnexa, and uniform irradiation of the entire potentially cancer-bearing areas of the pelvic floor and walls by mould technic, while protecting the rectum and bladder with appropriate shields and displacing the small intestine out of the pelvis during the treatment period. Such a method is under development at this time, and it was for this reason, in part, that the present study was undertaken.

Surgery, to offer a reasonable chance of cure, must be so extensive that the patient is subjected to an excessive risk of mortality and morbidity. This study indicates that irradiation, in average hands, promises a great likelihood of cure with a considerably diminished risk. Surgically treated patients were selected carefully as to age, general condition, and early stage of disease (except for the 2 undergoing exenteration). It is reasonable to assume that mortality and morbidity would have been much higher had the operative series included poorer risks, older patients, and those with more advanced disease.

The experience in this hospital suggests that radical surgery is not indicated for the primary treatment of invasive carcinoma of the cervix under ordinary circumstances. The experiences reported with experimental surgery under ideal conditions by master surgeons are by no means comparable to results obtainable under average circumstances by ordinary radiation therapists.

SUMMARY

The results of irradiation and surgery as observed in a series of 231 cases of carcinoma of the cervix at Parkland Memorial Hospital, Dallas, Texas, have been presented. The results with irradiation compare favorably with those reported in the *Annual Report* from Stockholm.

Results with surgery were less favorable than with irradiation both with respect to morbidity and mortality, and it is concluded that operation is not indicated as the primary treatment of invasive car-

cinoma of the cervix. A plan is suggested combining the advantages of both therapeutic procedures.

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REFERENCE

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SUMMARIO IN INTERLINGUA

Carcinoma del Cervice Uterin: Un Studio de Dece Annos Con Un Comparation del Resultatos Obtenite per Irradiation e per Chirurgia Radical

Es presentate un studio comparative del resultatos obtenite inter 1944 e 1955 in 231 casos de carcinoma del cervice. Duo centos del patientes esseva tractate per irradiation, 37 per chirurgia. Sex patientes recipeva therapias chirurgic e radiational e es tabulate in ambe categorias. Le diagnose esseva establite histologicamente in omne le casos. Le stadio del carcinoma in le casos individual esseva determinate in conferentias juncte del servicios radiologic e gynecologic. Vinti-quatro patientes representava Stadio I; 29, Stadio II; 75, Stadio III; e 63, Stadio IV. Nove patientes esseva irradiate pro recurrentias de cancere.

Le radiotherapia consisteva de varie combinationes de roentgeno-radiation externe e transvaginal e del application intracavitari e interstitial de radium.

Nulle mortes occurreva como resultato del irradiation. In 163 patientes (81,5 pro cento), nulle significative morbiditate radiational esseva notate. In 29 patientes (14,5 pro cento), le morbiditate esseva moderate; in 8 (4 pro cento), illo esseva sever. Le absentia de mortalitate per radiation e le basse morbiditate radiational es digne de nota in vista del facto que 71,8 pro cento del patientes representava Stadios III e IV. Le superviventia cinquenne inter 110 patientes tractate initialmente durante le prime cinque annos del studio esseva 26,4 pro cento (29 patientes). Sex patientes escappava al observation de consecution e es includite inter le victimas de cancere. Le periodo total de hospitalisation pro le 200 patientes irradiate esseva 4.445 dies. Isto corresponde a un periodo medie de 22,2 dies per patiente.

Ex le 37 patientes con therapia chirurgic, 2 esseva subjicite a exenteration pelvic e 35 a hysterectomia radical e a lymphadenectomia pelvic. Le mortalitate operatori in iste gruppo esseva 13,5 pro cento (5 patientes). Le combinate incidentia de morte e morbiditate sever in le patientes a hysterectomia e lymphadenectomia pelvic es 45,7 pro cento (17 ex 35 patientes). Il es non ancora possibile determinar le superviventia cinquenne in iste gruppo. Nulle patiente superviveva qui exhibiva diffusion de cancere ultra le cervice mesme. Pro le patientes chirurgic, le valor medie del periodo total de hospitalisation (incluse le hospitalisation requirite pro complicationes) esseva 47,5 dies. Isto es plus que duo vices le periodo medie in le gruppo de patientes irradiate.

Super le base del alte incidentia de mortalitate e morbiditate chirurgic e le longe periodo de hospitalisation del patientes assi tractate in comparation con le plus favorabile aspectos del irradiation, le autor conclude que chirurgia radical es generalmente non indicate como tractamento primari de carcinoma invasive del cervice. Le experientias reportate super le base de chirurgias experimental, executate sub conditiones ideal per chirurgos maestro, es certo non a comparar al resultatos obtenite sub conditiones de routine per ordinari therapeutas de radiation.

Calcification in Gastric Carcinoma

Case Report[1]

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PETTUS G. SECREST, M.D., and B. C. SHACKFORD, M.D.

CALCIFICATION in gastric carcinoma is an extreme rarity. Batlan, in a recent review of the literature, recorded what appears to be the only case in the American literature. He was able to find 7 examples in the foreign literature, 5 of which appear to have been proved. The purpose of this paper is to report an additional case, bringing the total to 9

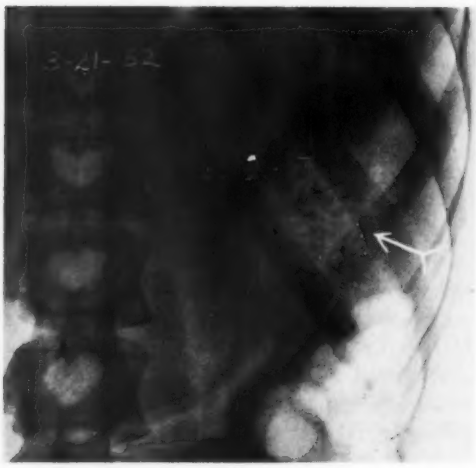

Fig. 1. Fairly extensive stippled calcification in the gastric carcinoma demonstrated on a preliminary film of the abdomen March 21, 1952.

and the number of proved cases to 7. A few examples which were discovered on pathological examination, but without roentgenographic study, are not included in these totals.

CASE REPORT

A white female, 27 years of age, was first seen at the Harriman Jones Clinic and Hospital on March 19, 1952, complaining of intermittent abdominal pain—in the right upper quadrant and epigastrium—present since November 1951. During the preceding three weeks the abdominal pain had become more severe and the patient had experienced pain also

Fig. 2. Film demonstrating the barium-filled distorted gastric lumen. The arrows mark the site of the gastric carcinoma. On the original films they were directed to the area where the calcification was readily visible.

in the right shoulder and right side of the neck. There had been anorexia since the onset of the pain but no material weight loss. No history of melena or hematemesis was obtained. Vomiting had occurred on several occasions. The past history was not significant. The family history was also noncontributory and was negative for malignant neoplasm.

The findings on physical examination were essentially normal. No abnormal masses or organs were palpated. Laboratory findings were as follows: red cell count 4,820,000; white cells 9,300; hemoglobin 16.4 gm. (96 per cent); urinalysis normal; serology negative.

On March 21, 1952, a preliminary film of the abdomen showed a 3 × 6-cm. area of stippled calcification in the left upper quadrant, medial to the splenic silhouette (Fig. 1). This calcification was demonstrated to be within a mass in the pars media of the stomach. The mass, 7 cm. in length, lay posteriorly and extended to both the lesser and greater curvatures. The mottled calcification

[1] From the Harriman Jones Clinic and Hospital, Long Beach, Calif. Accepted for publication in May 1956.

occupied its more lateral portion (Fig. 2). Roentgen findings were consistent with gastric carcinoma, with the unusual finding of calcification within the neoplasm.

The patient was operated on elsewhere on March 29, 1952, a subtotal gastrectomy being done. The pathological diagnosis was "mucoid carcinoma simplex of the stomach." Metastases were present in one regional lymph node. The pathologist described the cut sections of the tumor as containing chalky masses having the appearance of barium.

The patient's clinical condition was remarkably satisfactory until October 1954. Although at this time she was asymptomatic, a routine gastrointestinal x-ray study on Oct. 9 revealed recurrence of the amorphous mottled calcification in the medial part of the left upper quadrant of the abdomen (Fig. 3). This was shown to be in recurrent tumor in the gastric stump, immediately proximal to the gastrojejunal stoma on the lesser curvature. The calcification occupied an area measuring 3 × 5 cm. and corresponded to the filling defect in the stomach

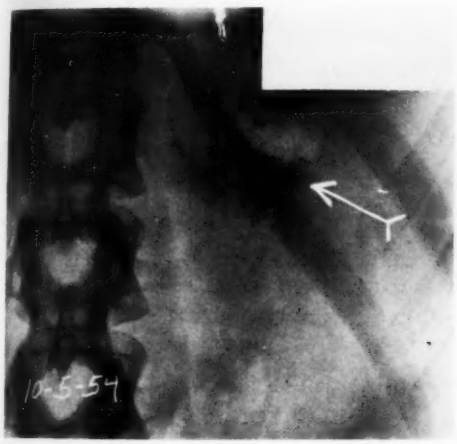

Fig. 3. Film of Oct. 5, 1954, showing recurrent stippled calcification in the left upper quadrant of the abdomen. This was shown to lie in the gastric remnant immediately adjacent to the gastroenterostomy stoma (see Fig. 4).

remnant (Fig. 4). This represented recurrence of gastric carcinoma, again demonstrating the unusual finding of calcification within the tumor.

In view of the patient's otherwise satisfactory condition, she was again operated upon, on Oct. 14, 1954. A mass involving the stomach, jejunum, and retrogastric lymph nodes was found. The mass and the remainder of the stomach and spleen were removed. A substitute stomach was made from the transverse colon.

A detailed microscopic examination was reported as follows: "Sections from the stomach show exten-

Fig. 4. Filling defect in the gastric remnant, representing recurrent gastric carcinoma.

Fig. 5. Roentgenograms of gross sections of the recurrent gastric carcinoma, demonstrating the extensive calcification within the tumor.

sive invasion of the entire wall by masses of large, rounded and polyhedral, pale cells with eccentric nuclei and cytoplasm filled with droplets of mucoid material. These cells, which resemble Krukenberg's cells, are partially separated into groups by fibrous trabeculae. Some portions of the mucosa contain large numbers of them, and they are also found

throughout the muscularis and serosa, in the adjacent fatty tissue, around many of the lymph nodes, and within some of the nodes, where they are exceedingly difficult to differentiate from histiocytes. In some regions these tumor cells are surrounded by much mucoid material. Some of the sections show small, rounded bodies from about 2 to 15 microns in diameter, which take a weak hematoxylin stain. Some show concentric rings. These resemble small deposits of calcium and are found in the mucosa of the malignant portion. They appear to occur as aggregates in the interstitial tissue, but it is difficult to be certain. Some are within the cells, many of which are of the Krukenberg signet-ring type. These aggregates are considered to be consistent with the chalky appearance of the mucosa on gross examination. Sections from the most mucoid part of the neoplasm show considerable necrosis of the tumor cells, and here there are also small calcified spheroids, several of which appear to be intracellular and suggest calcific deposition in the tumor cells."

Roentgenograms of the gross sections of the recurrent tumor showed extensive areas of calcification (Fig. 5).

SUMMARY

1. A case of gastric carcinoma with calcification is reported.

2. This is thought to be the second case in the American literature and the ninth in the world literature in which calcification has been visualized roentgenographically in a gastric carcinoma.

3. The case is of additional interest because of the roentgen demonstration of calcification in a recurrence in the gastric remnant following initial subtotal gastrectomy.

REFERENCE

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211 Cherry Avenue
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SUMMARIO IN INTERLINGUA

Calcification in Carcinoma Gastric
Reporto de un Caso

Es reportate un caso de carcinoma gastric con demonstration roentgenographic de calcification. Il pare que isto es le secunde caso in le litteratura american e le none in le litteratura mundial in que le calcification de un carcinoma gastric esseva visualisate roentgenographicamente. Le caso es de interesse additional proque il se tracta del demonstration de calcification in un carcinoma recurrente in le portion gastric remanente post un initial gastrectomia subtotal.

An Improved Technic for Double Contrast Examination of the Colon by the Use of Compressed Carbon Dioxide[1]

GEORGE LEVENE, M.D., and S. A. KAUFMAN, M.D.

DOUBLE CONTRAST examination of the colon has proved itself an important roentgenologic procedure for the detection of early neoplasms and for the demonstration of gross structural changes of the mucosa occurring in other types of disease. Since the original description of this technic by Fischer (1) in Germany and its development and refinement by Weber (2), Stevenson (3, 4), and others, it has remained, essentially, a method whereby air is introduced to distend the barium-coated walls of the colon. In our attempts to produce uniformly satisfactory examinations with the least inconvenience to the patient and examiner, we have resorted to the use of compressed carbon dioxide instead of air. We believe this to be a refinement of technic which possesses several advantages.

METHOD

After a preliminary barium enema study and evacuation of the barium, the patient is again observed fluoroscopically. If there has been adequate emptying of the bowel, additional routine postero-anterior and lateral films are made. Spot-films and other views are taken as indicated. It must be emphasized that satisfactory double-contrast films cannot be obtained if too much barium remains in the colon. A catheter is inserted into the rectum and carbon dioxide is allowed to flow into the bowel. The carbon dioxide is supplied by a small tank of the compressed gas (Fig.1), which is equipped with two gauges—one, a flow meter on a reduction valve; the other, a tank pressure gauge. The flow of gas is regulated, by turning the regulator on the reduction valve, to a rate of 1.0 to 1.5 liters per minute. When the proper rate of flow is obtained, the gas supply is shut off by turning the main valve on the tank. *The regulator on the reduction valve must not be disturbed.* As a precautionary measure, the rate of flow must be regulated *before* the catheter is inserted into the rectum. Filling of the colon with gas is observed fluoroscopically, additional films are made, and the patient is then permitted to go to the toilet.

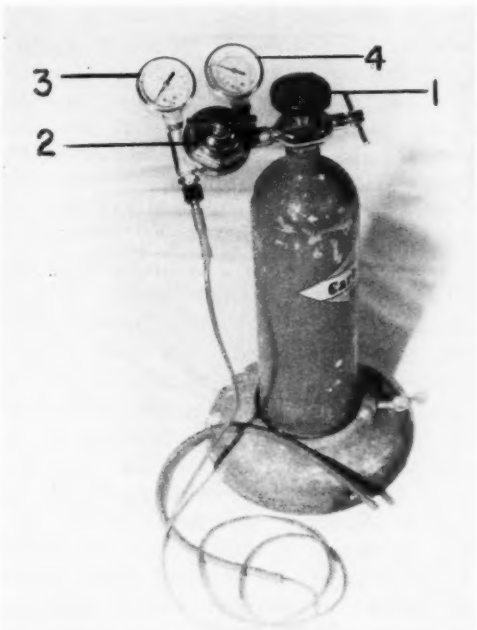

Fig. 1. Small portable tank of compressed carbon dioxide. The tank valve (1) is opened and the rate of flow adjusted by turning the regulator on the reduction valve (2), until a reading of 1.0 to 1.5 liters per minute is indicated on the flow meter (3). The tank valve is then shut. After the rectal tube has been inserted, the tank valve is opened and gas allowed to flow into the colon. The regulator (2) must not be disturbed. Gauge (4) indicates pressure of gas in tank.

In preparing barium suspension for an enema, we have found the optimum temperature of the water to be 41 °F. In our geographical area, water at this

[1] From the Departments of Radiology, Massachusetts Memorial Hospitals and Boston University School of Medicine, Boston, Mass. Accepted for publication in May 1956.

temperature is readily obtained from the cold water faucet in winter; at other times, the water is cooled to the proper temperature. The use of cool water has two advantages: First, the colon shows a greater tolerance for the enema, possibly because the mucosa is subjected to the slight anesthetizing effect of cold. Second, all gases are more soluble in cold liquids than in warm liquids, so that the tendency for bubble formation is reduced by the lower temperature in the colon.

ADVANTAGES

1. The absorption rate of gas from the colon depends largely on the partial pressure gradient between the bowel lumen and the venous blood. The average partial pressure of carbon dioxide in venous blood, with the subject at rest, is 46 mm. Hg, while the average partial pressure of nitrogen in venous blood is 573 mm. Hg (5). According to experimental work by McIver, Redfield, and Benedict (6), carbon dioxide is absorbed from the bowel approximately one-hundred fifty times as rapidly as nitrogen. Since nitrogen constitutes 79 per cent of air, air is absorbed slowly. After completion of the examination, such gas as is not expelled by rectum is quickly absorbed. The duration of the discomfort incident to double contrast enemas is thus minimized.

2. In case of accidental perforation of the bowel, dangerous complications are reduced and the duration of ectopic emphysema (abdominal, interstitial, mediastinal) is significantly shortened.

3. The use of a tank permits a smooth, continuous flow of gas without sudden bursts of increased pressure, such as occur with the ordinary insufflator. The patient is much more comfortable during the procedure, allowing a more careful and less hurried examination.

4. The possibility of embolism, by entrance of gas through a patulous bleeding vessel, is entirely eliminated, since unlike air, carbon dioxide combines with hemoglobin and goes into chemical combination and solution in the plasma immediately upon entering the blood stream.

Sufficient gas for proper contrast study of the colon, at most 1.5 liters of carbon dioxide, is introduced in less than one minute. Even if this entire amount were immediately absorbed by the blood stream (which it is not) and were diffused uniformly throughout the extracellular fluid in the body, it would not be sufficient to produce respiratory acidosis. This danger, theoretically inherent in the technic, may therefore be disregarded.

It is not an uncommon practice to do a proctoscopic or sigmoidoscopic examination of a patient immediately preceding x-ray examination of the colon by barium enema. In these procedures air is used to distend the bowel for better endoscopic visualization. Most often, a large amount of air still remains in the colon when the patient presents himself in the x-ray department, and radiologists are quite familiar with the difficulty of conducting a proper fluoroscopic examination under such conditions. With the use of carbon dioxide, instead of air, to distend the bowel for proctoscopy or sigmoidoscopy, the amount of residual gas and its attendant disadvantages would be markedly reduced.

SUMMARY

A new method for double contrast study of the colon is presented, using compressed carbon dioxide instead of air. This procedure is more comfortable for the patient and more convenient for the radiologist. It also obviates possible dangers inherent in the use of air.

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ACKNOWLEDGMENT: We wish to express our thanks to Dr. Burnham S. Walker, Professor of Biochemistry, Boston University School of Medicine, for his advice and assistance.

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SUMMARIO IN INTERLINGUA

Un Meliorate Technica del Examine Colonic a Duple Contrasto per Medio de Comprimite Bioxydo de Carbon

Es presentate un nove methodo pro le duple contrasto del colon. Illo consiste in le uso de comprimite bioxydo de carbon in loco de aere. Le avantages del methodo, que se ha monstrate plus confortabile pro le patiente e plus commode pro le radiologo, include la rapide absorption de bioxydo de carbon (150 vices plus rapide que aere), le reduction del risco de complicationes periculose in caso de perforation accidental del intestino, le uniforme e continue fluxo de gas como resultato del uso de un tank, e le complete elimination del possibilitate de embolismo. Es etiam proponite que bioxydo de carbon es usate in loco de aere in examines protoscopic e sigmoidoscopic immediatemente ante le execution de studios a clyster de barium. Isto resultarea in un reduction significative del residuo de gas e del consequente disavantages.

Diverticula of the Appendix

A Case Report[1]

ASA B. FRIEDMANN, M.D.

THE FINDING OF diverticula in the gastrointestinal tract is an exceedingly frequent occurrence in the course of routine x-ray examination. They have been encountered all the way from the upper esophagus to the lower sigmoid. They vary from symptom-producing saccular protrusions to asymptomatic incidental discoveries. It is the purpose of this brief presentation merely to record a most unusual set of diverticula arising in the vermiform appendix. In this instance the discovery was incidental and bore no relation to the patient's symptoms or to the clinical picture. Serial small bowel films were obtained, and the terminal ileum was well demonstrated, ruling out the possibility that it was the site of the diverticula.

The rarity of diverticula arising in the appendix suggests the need for recording this case in the literature. Maissa found a single case in 10,000 serial examinations of the intestinal tract.

Fig. 1. Colon filled by barium clysma. Filled appendix shows seven separate diverticula arising along its axis.

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[1] Accepted for publication in May 1956.

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SUMMARIO IN INTERLINGUA

Diverticulos del Appendice: Reporto de un Caso

Ben que diverticulos del vias gastrointestinal occurre frequentemente, le constatation de diverticulos in le appendice es rar. Es presentate un caso in que septe separate diverticulos esseva demonstrate roentgenologicamente al longo del axe del appendice. Iste constatation esseva completemente incidental. Le phenomeno habeva nulle relation con le symptomas del patiente o con su stato clinic.

Treatment of Hemangiomas with the Strontium-90 Beta-Ray Applicator[1]

DAVID M. SKLAROFF, M.D.

BETA RAYS emanating from radium, radon, and radium D and E have been used for therapeutic purposes about the eye for many years. Recently the use of the strontium-90 beta-ray applicator was described in the treatment of superficial tumors of the eyelids and conjunctiva, vernal conjunctivitis, vascularization of the cornea, and corneal ulcers (1).

Since beta rays penetrate only a few millimeters of tissue, many hemangiomas of the "strawberry mark" variety, being quite superficial, seemed to be suitable for treatment with this form of radiation. Strontium 90 is especially useful, since it fulfills all the criteria of ideal beta-ray therapy, that is, a long half-life (twenty years, so that frequent replenishment is unnecessary), energetic beta particles which permit sufficient penetration of tissue, absence of gamma rays, affording ease of protection, and ease of manipulation. Since 1952 we have treated several superficial hemangiomas quite successfully with the strontium-90 applicator. Because the applicator has a high output of radiation, the treatment time is extremely short (measured in seconds). This fact alone is a great aid in the management of infants, who rebel at being restrained even for several minutes, which is the usual time for treatment with x-rays. In addition, the treatment is painless.

Physical Characteristics of Strontium 90: Strontium 90 is a fission product and is obtained from the Isotopes Branch of the U. S. Atomic Energy Commission. It has a half-life of twenty years and disintegrates through the emission of a beta particle with maximum energy of 0.65 million electron volts to form yttrium 90. Yttrium 90 has a half-life of sixty-two hours and emits beta particles with a maximum energy of 2.16 MEV to form the stable isotope of zirconium, namely zirconium 90. No significant gamma radiation is present. A plaque containing strontium 90 is thus a source of pure beta radiation with two continuous spectra, that of strontium 90 and of yttrium 90. In about twenty years the intensity of radiation which is emitted by the plaque and the radiation intensity resulting therefrom are dependent upon the millicurie strength, area of the radioactive deposit, and the degree of filtration by the metallic protective covering. This protective covering (approximately 100 mg./sq. cm.) is sufficient to reduce the number of beta particles which result from the disintegration of the strontium and yttrium to approximately 3 and 60 per cent of their original values, respectively. The beta particles, therefore, being emitted from this plaque will have essentially the characteristics of a pure yttrium-90 spectrum (with a maximum energy of 2.16 MEV) after it is passed through 100 mg. per square centimeter of filtration (2).

The depth dose for the strontium applicator is as follows:

Depth in Mm.	Percentage
0	100
1	50
2	25
3	15
4	6
5	2.8

Description of Applicator: The strontium applicator is manufactured by Tracerlab, Inc. It contains a 25-millicurie source and, when new, delivers 34.6 roentgen equivalent betas per second. The shaft is 6 3/4 inches in length, and a circular plexiglass protective shield, 4 inches in diameter and 1/4 inch in thickness, is provided, which can be moved along the

[1] From the Department of Radiology, Albert Einstein Medical Center, Northern Division, Philadelphia 41, Penna. Accepted for publication in February 1956.

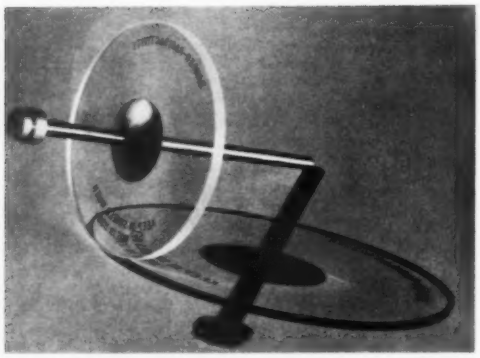

Fig. 1. The radioactive-strontium applicator.

areas for twenty-two seconds for a dose of 500 rep. One month later (May 29, 1953) definite improvement was noted, with marked fading in all treated areas. This continued (Fig. 2), and when the child was last seen (July 29, 1955), the cosmetic result was very good.

CASE II: A. S., a female infant of two and a half months, had a hemangioma in the left supraclavicular area, present since birth and gradually increasing in size. It measured approximately 2 × 3 cm., was deep red and slightly raised (1 or 2 mm.) and fragmented.

On Dec. 29, 1952, the strontium applicator was applied for ten seconds for a total of 250 rep in two areas. One month later, it was noted that the treated areas had started to fade. Improvement continued, but only in the treated area. On April 18, 1953, two additional areas were treated for twenty-two seconds for a dose of 500 rep. These new areas then started to fade, with an excellent cosmetic result at the last observation, on July 27, 1955 (Fig. 3).

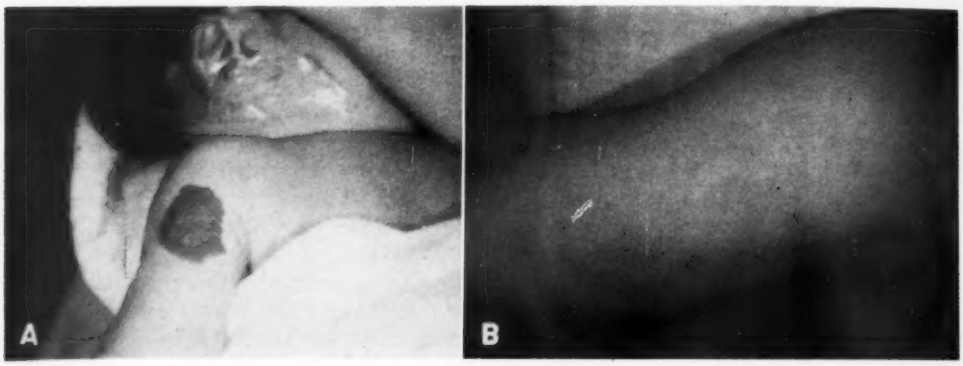

Fig. 2. Case I. A. Before treatment, April 30, 1953. B. Appearance two years later, July 29, 1955.

shaft to any desired position and will stop most of the radiation emitted by the source. The strontium plaque has an outside diameter of 12.7 mm., with an active diameter of 7.8 mm. It is covered by 2 mils of stainless steel and 10 mils of aluminum and is enclosed in a hermetic seal (Fig. 1).

Clinical Application: The strontium-90 beta-ray applicator has been used clinically in several cases of superficial "strawberry mark" hemangioma, being applied by direct contact to the skin with firm pressure. Two cases treated successfully will be described.

CASE I. S. W., a premature male infant one month of age, had a hemangioma on the right shoulder which had rapidly increased in size, until it measured 2.0 × 2.5 cm. It was deep red in color and slightly elevated (about 1 or 2 mm.). The strontium applicator was applied to each of three

DISCUSSION

Up to the present time 10 cases of hemangioma have been treated similarly, with quite satisfactory results. If, however, the hemangioma measures more than 2 mm. in thickness, this form of treatment is not used. The cosmetic results have been extremely good, and late effects on the skin, which are often seen with other forms of irradiation, have not been observed.

SUMMARY

The strontium-90 applicator has been used for the treatment of hemangiomas

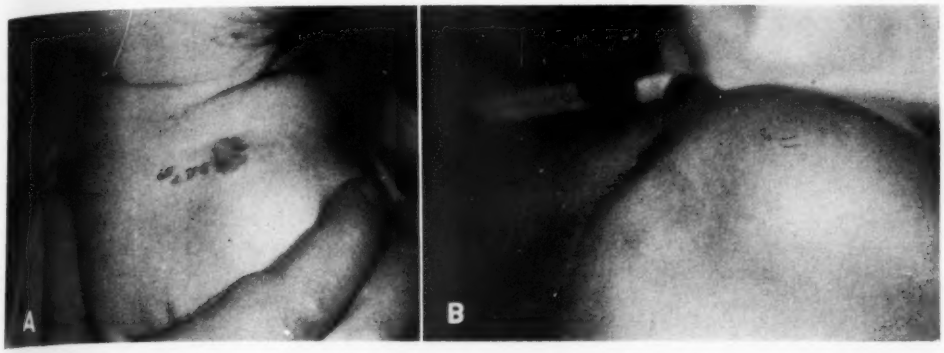

Fig. 3. Case II. A. Before treatment, Dec. 29, 1952. B. Appearance two and a half years later, July 27, 1955

of the "strawberry mark" variety. Its advantages over other methods are noted and 2 cases with excellent cosmetic results are described.

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SUMMARIO IN INTERLINGUA

Le Tractamento de Hemangiomas per Medio de Applicatores de Radios Beta ab Strontium 90

Le applicator de radios beta ab strontium esseva usate in le tractamento de hemangiomas del varietate "nevo de fraga." Le avantages de iste methodo in comparation con alteres include le longe medie-vita de Sr^{90} (vinti annos), le breve duration del tractamento (mesurate in secundas), le alte energia del particulas beta que permitte un sufficiente penetration, le absentia de radios gamma (con le resultato de un plus simple protection), e facilitate del manipulation. Iste forma de tractamento non se usa pro hemangiomas de un spissor de plus que 2 mm. Es describite duo casos in ambe le quales un excellente resultato cosmetic esseva obtenite.

Posterior Mediastinal Hemangioma[1]

S. B. FEINBERG, M.D.

MEDIASTINAL hemangiomas are lesions of rare occurrence, not usually included in the differential diagnosis of thoracic tumors. The entity was first reported in 1944 (1), and by 1955 a total of 19 documented benign mediastinal hemangiomas had been described, only 2 of which were in the posterior mediastinum (5).

While the histology of the cutaneous and mediastinal cavernous hemangiomas is similar, the latter are found far less frequently (1, 2, 5, 7, 8, 11, 12, 14, 16, 17, 18). Of 570 vascular tumors seen at Johns Hopkins Hospital before 1935, none were mediastinal (6). Adams (1) and Bergstrom (2) cited reports of pericardial and diaphragmatic hemangiomas as well as one of hemangioendothelioma. In one study, invasion of the mediastinum by a thoracic wall hemangioma was described (3).

The natural history of the infantile cavernous hemangioma is in general one of early growth, with gradual regression by the fifth year (9, 10); the mediastinal lesion, on the other hand, does not regress spontaneously. It occurs in both sexes and in all age groups. A routine chest radiograph is the usual mode of discovery. Symptoms occur only when, because of its size or location, the tumor produces compression on adjacent vital structures.

These tumors must be differentiated from the more common teratomas and thymomas anteriorly, and from the neurogenic tumors, neurofibroma, neurofibrosarcoma, and neuroblastoma, posteriorly. Enteric cysts should also be included in the differential diagnostic possibilities.

Treatment is surgical (5, 14, 18). Radiation has been successful in only one known instance (5).

In spite of the vascular structure of mediastinal hemangiomas, no major communication exists between the great vessels and the tumor. Histologically the growth is composed of endothelial-lined, blood-filled sinuses, sometimes with the incorporation of complex mesenchymal elements (15). The lesion may be localized or, in spite of its histologic benignancy, may be invasive. Some writers include the malignant hemangioendothelioma in the same group (2, 4, 14). To some, the occasional association with teratoma has suggested a common origin (4, 13, 15).

Because of an interesting roentgen finding, the following case is considered worthy of report.

L. M., an 8-year-old male, in good general health, had a survey chest film showing a mass superimposed on the left mediastinal and cardiac shadows.

Physical examination was negative. Positive laboratory findings were limited to two consecutive hemoglobin values of 13.2 and 13.8 gm.

Fluoroscopically, a non-pulsating left paravertebral mediastinal fusiform mass was evident, extending from the mid-dorsal level to and through the diaphragm. In spite of the clear-cut appearance in anteroposterior and postero-anterior views (Figs. 1 and 2), rotation of the patient resulted in blurring and eventual obliteration of the borders of the mass (Figs. 3 and 4). This was observed on repeated radiographic studies, its exact significance being indeterminate. Neurogenic tumor seemed the most likely diagnosis

The surgical findings corresponded to the radiographic picture. A tag of tumor extended through the diaphragm. The mass was spongy and yellow-gray. The postoperative diagnosis was neuroblastoma, and with this the gross pathologic impression was in agreement.

The microscopic examination disclosed large, irregular blood-filled vessels and sinuses, some of which were thrombosed. Smooth muscle was distributed between the vessels. Fat lobules and nerve bundles were also present (Fig. 5). *Diagnosis:* Benign cavernous hemangioma.

DISCUSSION

The tumor was silent, being discovered on a routine chest roentgenogram. The

[1] From the Department of Radiology, Mt. Sinai Hospital, University of Minnesota Hospitals, Minneapolis, Minn. Accepted for publication in May 1956.

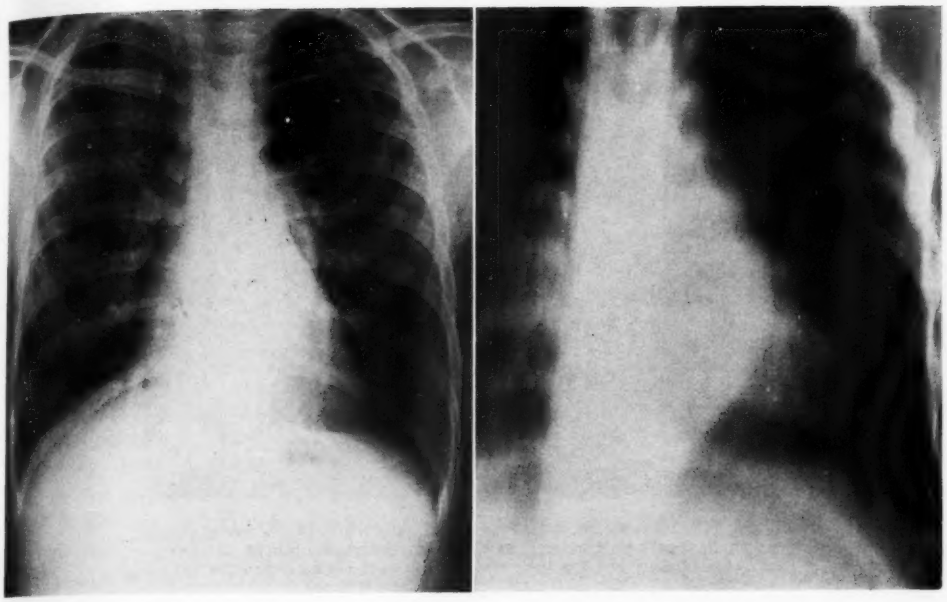
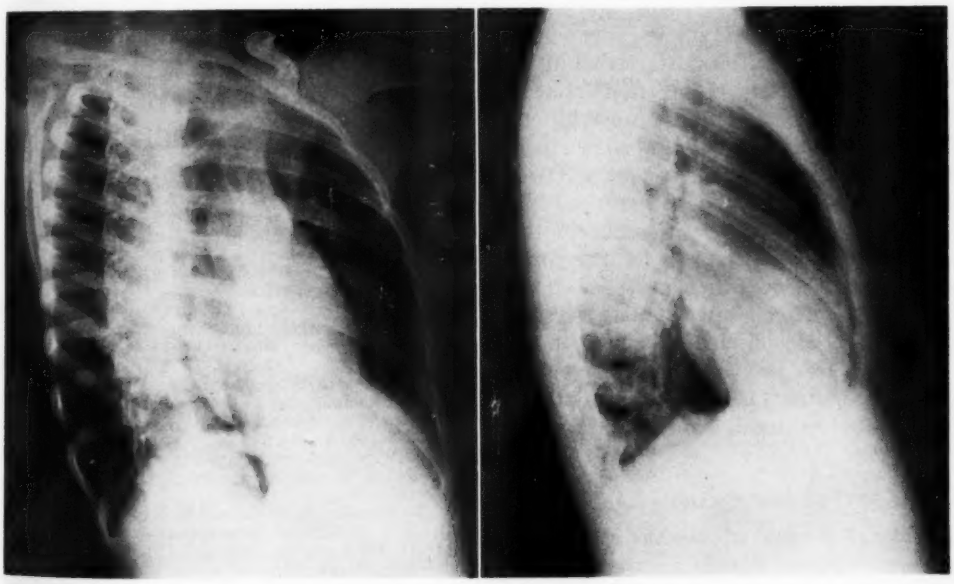


Fig. 1 (left). Postero-anterior chest film showing a fusiform mass on the left which is superimposed on the aortic, cardiac, and diaphragmatic levels.
Fig. 2 (right). Anteroposterior planigraphic cut through the posterior mediastinal mass, showing its extension through the diaphragm.



Figs. 3 and 4. Left anterior oblique and left lateral views showing what was observed at the fluoroscopic examination, *i.e.*, virtual disappearance of the mass from view.

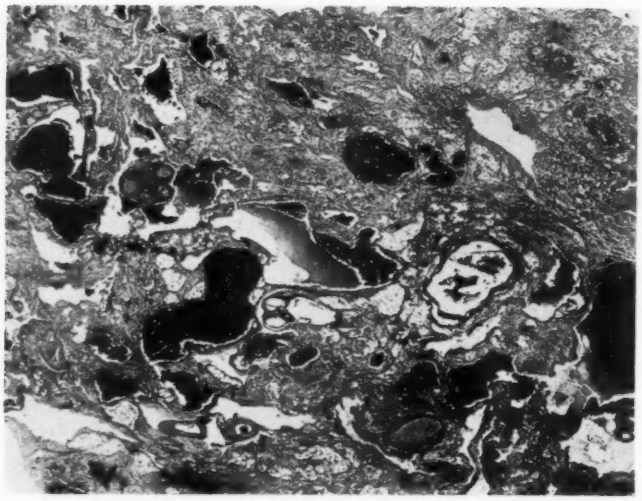


Fig. 5. Microscopic section showing large irregular blood vessels, some of which are thrombosed. Smooth muscle, fat lobules, and nerve bundles are also present but for the most part require higher magnification for identification. *Diagnosis:* Benign cavernous hemangioma.

radiographic findings as reported in the literature make no mention of the observation described above, *i.e.*, the virtual disappearance of the mass on repeated rotation, even though it was sharply delineated on anteroposterior and postero-anterior films. The fact that the compact and more dense anterior teratomas and thymomas and posterior neurogenic tumors are clearly outlined in all projections suggests a differential diagnostic criterion. The difference in tissue density probably accounts for the tumor's softness to the roentgen ray as well as to palpation. This point is raised in order to suggest consideration of hemangioma —or, to use the more inclusive term, mesenchymoma (15)—in the diagnosis of mediastinal tumors which exhibit this finding.

SUMMARY

A brief review of mediastinal hemangiomas is given, and a case report of this tumor, located posteriorly, is presented. A unique radiographic feature was the virtual disappearance of the mass on repeated rotation even though it was sharply delineated on anteroposterior and postero-anterior views. This is suggested as a possible differential diagnostic clue.

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SUMMARIO IN INTERLINGUA

Hemangioma Postero-Mediastinal

Es presentate un breve revista de hemangiomas mediastinal, sequite per le reporto de un caso de iste tumor in location posterior. Un phenomeno radiographic unic esseva le plus o minus complete disparition del massa post le repetite rotation de patiente durante le examine, sed le massa remaneva clarmente delineate in le perspectivas antero-posterior e postero-anterior. Viste le facto que le compacte e plus dense teratomas e thymomas anterior e tumores neurogene posterior es clarmente delineate in omne projectiones, on pote stipular que le supra-mentionate observation es possibilement un indicio in le diagnose differential.

Spondylolisthesis: An Autopsy Study

Preliminary Report[1]

PALMER E. WIGBY, M.D., and JOHN R. THOMAS, M.D.

Houston, Texas

OUR MAIN PURPOSE in presenting a paper on spondylolisthesis is the feeling that a certain condition of the skeleton could be congenital in origin and still not be present at birth. We have always maintained that the pedicle clefts of spondylolisthesis are congenital in origin, and lawyers often ask, and rightly, what evidence exists to support that contention.

There are several unanswered questions relating to the genesis of the clefts. If it is possible for an injury to involve only one or both isthmi of a vertebra, how does one go about proving that a fracture or a developmental disturbance is responsible? Another unanswered question is: why should 4 to 6 people out of every 100 the world over have clefts in either or both of the lower two lumbar vertebrae? One would expect occasionally to find 8 or 10 in a series of 100 and perhaps 2 or 3 in the next 100, but that is not the case.

Even though a congenitally weak isthmus predisposes to fracture of the area, we must admit the presence of injury. We know of no case in the literature or elsewhere, however, in which x-ray films showed normal isthmi on one occasion and subsequently demonstrated clefts. Most of the evidence thus points to a congenital origin of these defects, but actual proof is another matter.

It has been argued that, even though the proof is found, the treatment is not altered. The answer to this is that it is of prime importance to be able to say with certainty whether injury can produce the clefts. While we are not able to prove anything on the basis of the evidence available to us at the present time, we hope at least to stimulate thought, and possibly work, among scientists, particularly those investigating skeletal development, so that a reliable conclusion will eventually be reached. We have examined histologically only a small number of cases to date and all have shown normal development.

One of us (P. E. W.) recently saw a case of spondylolisthesis, Grade II, in a child of five years, whose mother insisted that he had never had any sort of injury. It may be said that a birth injury was involved, but this does not seem likely, since there was no difficulty at birth and certain investigators have been unable to produce fractures or clefts of the isthmus or any portion of the pars interarticularis of the fifth lumbar by forced manual flexion of the lumbosacral joint in newborn infants coming to autopsy.

Hitchcock (2), in 1940, reported that he produced fractures of the isthmic area by hyperflexion of infant cadaver spines, but he fails to state what method was used to determine the presence of fracture—whether roentgenographic or pathological examination—and shows no example. We were unable to determine from his article what criteria he used for the existence of fracture. We believe that by our method fracture callus can be distinguished from a congenital cleft if either is encountered.

Serial microscopic sections of neural arches are being made in a search for bony defects, sites of weakness, unexpected ossification centers, non-union of fractures, and other possible lesions. Anatomic confirmation as well as evaluation of radiologic interpretations, can thus be assured. By using an over-sized microtome, intact microscopic sections of entire vertebrae can be prepared and studied.

Various orthopedists (3) and others

[1] Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11–16, 1955.

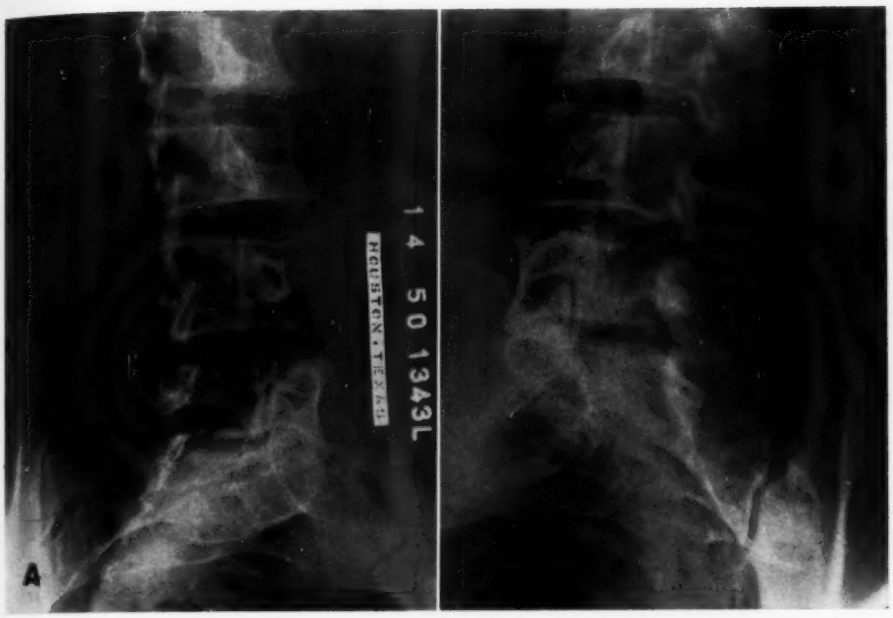

Fig. 1. A. Case showing gradual decrease in size of the isthmus of each lumbar vertebra from the second level downward. B. Localized narrowing of the isthmus of the fourth lumbar vertebra with a wide isthmus at the fifth.

have held that, if the separate neural arch occurs in 5 per cent of fully developed or adult skeletons, and if the separation is on a congenital basis, then the defect will occur in at least 5 per cent of skeletons of the newborn. We are trying to determine why that seems not to be true on the basis of the evidence accumulated to date.

It appears that normal childhood living produces a break or cleft in the congenitally narrow or weak isthmus. In our opinion this could be proved if enough fifth lumbar vertebrae could be examined at all ages up to about sixteen years. If at least one hundred specimens for each age were available for microscopic study, the problem should be definitely solved. This, of course, involves a tremendous amount of work, but in the meantime we should try to collect as much evidence as we can. In the search, we are certain eventually to come upon microscopic evidence of separate ossification centers or evidence of weakness or fracture of the area in question, and it may be that we will obtain the desired proof on much less material. We are ourselves collecting all the autopsy material we can find pertaining in any way to spondylolisthesis, and we hope after two or three years to have something worth reporting.

If ordinary childhood activity produces the hiatus or cleft, then one possible reason we cannot show bony union roentgenographically is that the continued irritation or stress produces what may be referred to as a "non-union fracture," but this is still the end-result of congenital weakness of the vertebral arch.

The condition differs from stress fractures in that the latter—which involve the metatarsal bones in the majority of cases and the tibia and fibula in a minority—show exuberant bony callus. We have never seen roentgen evidence of bony callus at a break of the isthmus of the fourth or fifth lumbar vertebra. Roche in 1948 (4) reported such a case involving the laminae of the third lumbar vertebra, but in his case the lesion was not con-

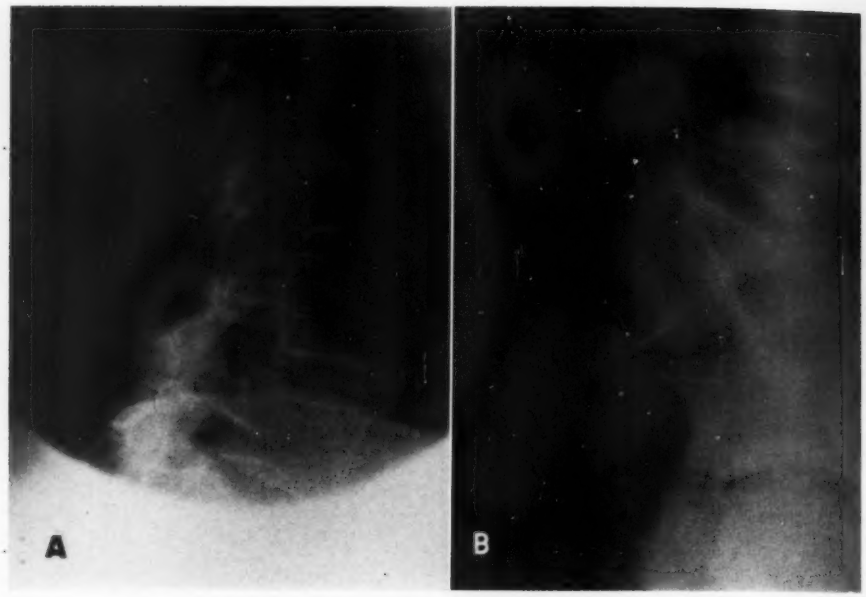

Fig. 2. A. Spondylolisthesis without clefts and with hemangioma of the fourth lumbar body. The hemangioma may have something to do with the long anteroposterior diameter. B. No clefts in a patient with no associated osseous pathology of any sort.

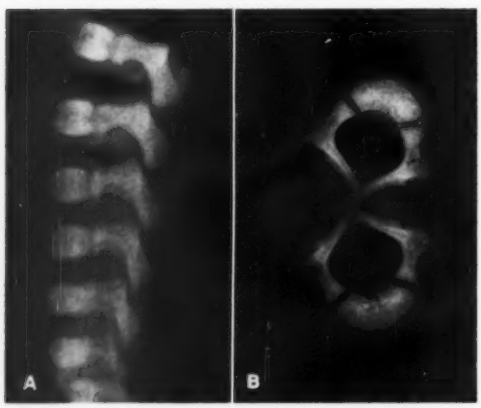

Fig. 3. X-ray appearance of a normal fifth lumbar vertebra from a nine-month fetus.

fined to the isthmus. Newman (6), of London, claims to have seen a fracture of the isthmus of the fourth lumbar vertebra with later displacement and x-ray demonstration of bony callus, but in his roentgenogram, as reproduced, it is impossible to determine whether or not bony callus exists.

The occasional vulnerability of the isthmus of the fifth lumbar vertebra is well brought out by the observation that in a small percentage of persons the isthmus decreases in size from the first to the fifth segment. This percentage we believe to be less than the approximate 5 per cent given as the usual incidence of spondylolisthesis. A similar observation was reported by Batts (3) in his article on spondylolisthesis published in 1939. It is illustrated as Figure 1 of the present paper and was shown by Batts in an autopsy specimen (his Fig. 3).

In reviewing 1,017 x-ray studies of the lumbar spine, 52 cases of spondylolisthesis were found (Table I). Seventy-one per cent of this series were of Grade II; none were of Grade III or IV. There were 16 cases (29 per cent) of Grade I, so-called

TABLE I: FIFTY-TWO CASES OF SPONDYLOLISTHESIS FOUND IN 1,017 EXAMINATIONS (5.1 per cent).

Grade I	16 (29%)
Grade II	37 (71%)
Grades III and IV	None
Two levels (in same patient)	1
Unilateral defects	3
Without pedicle defects	2

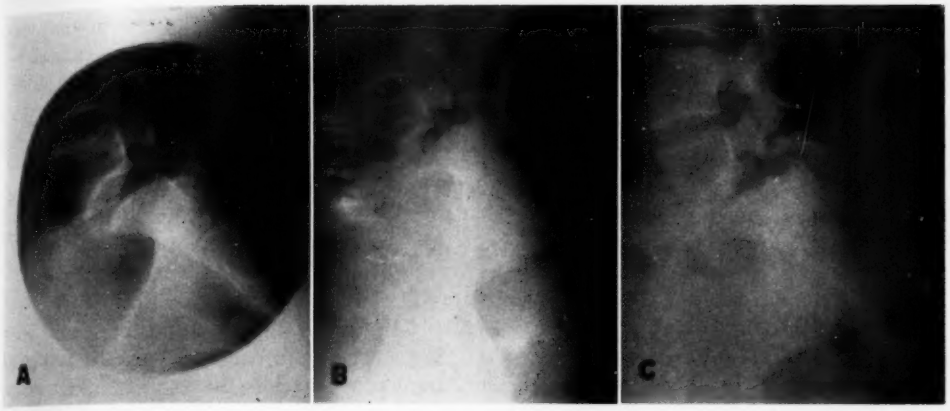

Fig. 4. Successive roentgenograms showing no slip over a ten-year period of active life. This is the usual situation, implying that whatever slip is found takes place over a very short period very early in life.

spondylolysis, and in 3 of these the clefts were unilateral. Most of the 52 patients were over forty years of age, although there were several around the age of twenty, as well as 1 five, 1 nine, 1 thirteen, and 1 fifteen. All of the group had complaints referable to the low back, except for the nine-year-old, in whom the spinal lesion was a coincidental finding during an examination of the colon. This was also a Grade II spondylolisthesis. Kleinberg (7) described a case in a child seventeen months old.

Three hundred and four consecutive x-ray studies of lumbar spines were reviewed recently by one of us (P. E. W.), and certain other findings were recorded (Table II). Reduction of the lumbosacral joint space was given particular attention, and it was found that in 51 per cent of the cases there was 50 per cent or less reduction of the space; in about 35 per cent there was more than 50 per cent reduction, and in 12 per cent the space was considered to be normal, *i.e.*, it was equal to the space above, which in turn was about the same as the third space. In several of the patients with a normal lumbosacral space there was reduction of the fourth space, and some showed reduction of the third space.

Among other anomalies noted was bilateral or unilateral sacralization or lumbarization of the segment at the lumbosacral junction, present in about 3 per cent. About 6 per cent of the patients showed either four or six separate lumbar vertebrae, and in about 1 per cent there were ununited secondary centers of ossification on the anterosuperior aspect of the fourth lumbar vertebra. Spina bifida of the first sacral segment was found in some 5 per cent of the cases. Vertebral body cupping was seldom seen (less than 1 per cent). Attention was paid to developmental wedging of the twelfth dorsal and first lumbar bodies, and one or the other, or both, was found wedged in at least 7 per cent of the cases. Varying degrees of scoliosis were observed in 9.5 per cent of the series. Exaggerated lordosis was present in about 30 per cent, and

TABLE II: INCIDENCE OF CERTAIN FINDINGS IN 304 CONSECUTIVE LUMBAR SPINE EXAMINATIONS

Sex and Race	
Male	207
Female	97
White	273
Colored	31
Spondylolisthesis (no Grades III or IV; 1 case with two levels involved.)	
Grade I	3
Grade II	13
Reduced lumbosacral joint space	
Over 50 per cent	94 (31%)
50 per cent and under	170 (56%)
Normal	40 (13%)
Transitional vertebra	
Unilateral	10 (3.2%)
Bilateral	11 (3.6%)
Exaggerated lordosis	58 (19%)
Scoliosis	29 (9.5%)
Developmental wedging of vertebrae	18 (6%)

absence of lordosis or vertical alignment in 5 per cent.

CLASSIFICATION

A large percentage of orthopedists in this country believe that the occurrence of clefts on both sides or on one side, but without any forward slip, should be referred to as spondylolysis, although Meyerding (5), in his classification, lists this as Grade I spondylolisthesis, or "prespondylolisthesis." His other grades are as follows: Grade II, a forward slip for a distance one-third of the anteroposterior diameter of the superior surface of the sacrum; Grade III, a slip of between one-third and two-thirds of the anteroposterior diameter; Grade IV, slipping from two-thirds to completely off the sacrum and anterior to the first sacral segment.

We have classified our cases according to this plan. The orthopedists who object to the use of the term "pre-spondylolisthesis" say that in using that term we presuppose or predict, or at least imply, that spondylolisthesis will develop, though in many cases no forward slip ever appears. This means that the matter of classification is not yet clarified. If the national orthopedic societies could agree upon a uniform classification, then a certain amount of confusion in terminology could be eliminated.

Those opposed to the classification we are using prefer the designation "spondylolysis" for our Grade I and classify the remaining cases as follows: Grade I, a slip equal to one-fourth of the superior diameter of the sacrum; Grade II, a slip equal to one-half of the superior sacral diameter; Grade III, a slip of three-quarters to complete displacement, with the fifth lumbar vertebra anterior to the sacrum, the same as Meyerding's Grade IV.

In the case of clefts at two levels, with displacement at one level and none at the other, it seems redundant to say that the patient is suffering from two conditions, spondylolysis at one level and spondylolisthesis at the other.

Newman (6) states that spondylolisthesis is due to lumbar instability caused by (*a*) congenital absence of the sacral ridge, associated with deficiency of the medial raphe of the lumbodorsal fascia and other posterior spinal ligaments; (*b*) congenital or acquired facet deficiency; (*c*) acquired deficiency of the lumbodorsal fascia, other posterior spinal ligaments, and the intervertebral disk.

The above is included to suggest that soft-tissue changes should be considered as a part of the cause of forward displacement in spondylolisthesis.

SUMMARY

It is maintained that the pedicle clefts characteristic of spondylolisthesis are congenital in origin, though they may not actually be present at birth. The actual break in the pars interarticularis is believed to be acquired during normal childhood, with subsequent forward displacement.

Since congenital narrowing of the isthmus is not invariably present, it may be assumed that in some 5 per cent of individuals (a figure corresponding to the incidence of cleft formation) there must be a congenital weakness of this structure. This assumption awaits proof.

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SUMMARIO IN INTERLINGUA

Spondylolisthese: Un Studio Necroptic
Reporto Preliminary

Nos mantene que le fissuras del pediculo que occurre como characteristicas de spondylolisthese es de origine congenite, ben que illos non es necessarimente manifeste al nascentia. Nos opina que le ver fractura del parte interarticular se acquire durante un normal infantia, con le subsequente displaciamento.

Proque un reduction congenite del largor del isthmo non es invariabilemente presente, on pote supponer que in circa 5 pro cento del individuos (un procentage que corresponde al incidentia de formation de fissura) il debe exister un debilitate congenite de iste structura. Iste supposition es ancora a provar.

Disulfide Reduction and Release of Iodide 131 Following Irradiation of I^{131} Labeled Proteins[1]

ROSALYN S. YALOW, Ph.D., and SOLOMON A. BERSON, M.D.

In previous communications (1, 2) the release of iodide 131 from x-irradiated I^{131}-labeled proteins has been reported. Further studies on the x-irradiation of insulin, serum albumin, and cystine have indicated the splitting of disulfide bonds and the possible role of reducing radicals in this cleavage. The effects of various protective agents on the liberation of iodide have also been investigated.

Native insulin and cystine have no free SH groups and do not reduce Fe^{+++}. Following irradiation at dosage levels of 200 and 35 kilorads respectively, these substances reduce Fe^{+++} in the absence but not in the presence of p-chloromercuribenzoate. A similar reaction has been demonstrated following the irradiation of serum albumin but not following irradiation of alanine and methionine under conditions similar to those employed with cystine.

Irradiation of insulin in a nitrogen atmosphere not only increases the Fe^{+++}-reducing effect, but also augments tremendously the release of iodide 131 from insulin. Since, in the absence of oxygen, the production of O_2H and H_2O_2 is minimized, and the concentrations of H and OH radicals are increased, either or both of the latter would appear to be primarily responsible for the changes observed. While it seems more likely that H atoms are responsible for the disulfide reduction and may also be involved in the release of iodide, the role of the OH radical in the liberation of iodide is suggested on the basis of the protective effect observed in the presence of O_2, H_2O_2 and iodide (all of which are presumed to effect rapid removal of hydroxyl radicals) and the production of similar changes with chemically produced hydroxyl radicals. At the same concentrations at which glycine, alanine, isopropylamine, histidine, and glucose exhibit no protection, five different hydroxybenzene derivatives are strongly protective, while phenylalanine is less protective than the phenolic analogues. These findings suggest that radiation-induced hydroxyl radicals release iodide 131 from the tyrosyl residues of insulin-I^{131} and are removed by the competitive phenolic derivatives.

These studies support the view that protective agents function by competing for radicals formed in the irradiation of water. They are in striking contrast, however, to most other organic systems studied, in the marked increase in radiosensitivity in the absence of oxygen and in the observations indicating a reduction of disulfide bonds.

Although no detectable alterations were observed with dried or frozen insulin-I^{131} at x-ray dosage levels of 800 kilorads, changes similar to those described were produced by cyclotron irradiation of dry specimens with 2×10^{13} deuterons/sq.cm.

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[1] From the Radioisotope Service, Veterans Administration Hospital, Bronx, N. Y.

Monte Carlo Calculations on the Spectrum of Scattered Radiation Produced in Water by X-Ray Beams of Interest in Radiotherapy

W. R. BRUCE,[1] Ph.D. and H. E. JOHNS,[2] Ph.D., F.R.S.C

The intensity flux of the scattered radiation from x-ray beams in low atomic number materials has been obtained by a combination of analytical and Monte Carlo methods. Analytical methods were used to calculate the intensity flux of first-order scatter, and Monte Carlo methods to estimate the spectrum resulting from scatterings of higher order. The electronic computer at the University of Toronto was employed to obtain case histories for a pencil-like beam of photons with initial energies of 50, 100, 200, 500 and 1,250 kev impinging at right angles on a water scatterer. From the characteristics of the penetration of a pencil of rays, the properties of the diverging beams used in radiotherapy were obtained.

Energy spectra were obtained for depths up to 20 cm. for areas of 25, 50, 100, and 400 sq. cm. and an infinite area. From these data for monoenergetic radiation, methods were developed to enable one to estimate the spectrum of scattered radiation produced by a continuous spectrum of incident radiations. By this means it is possible to estimate the spectral distribution of the scattered radiation for

* The papers presented here in abstract form were read at the Forty-second Annual Meeting of the Radiological Society of North America (Section C), Dec. 5, 1956. The abstracts were submitted for publication in November 1956.

depths of 0, 2, 5, 10, and 15 cm. and areas of 25, 100, and 400 sq. cm. and infinite area for radiations in the range 50 to 1,250 kev.

The energy absorbed, expressed as depth dose, was obtained for a number of incident spectra and compared with experimentally determined depth dose curves. The results were in good agreement.

[1] Graduate Student, Physics Department, University of Saskatchewan.

[2] Head of Physics Division, Ontario Cancer Institute and Professor of Physics, University of Toronto. Formerly, Professor of Physics, University of Saskatchewan.

Advances Toward a Stable Sensitive Iron Dosimeter[1]

GAIL D. ADAMS, Ph.D., and
WILLIAM R. BALKWELL, B.A.

Utilization of the conventional ferrous sulfate dosimeter indicates the desirability of a chemical system which exhibits greater stability and is more sensitive to energy absorbed from radiation. Greater apparent sensitivity has been achieved (*a*) by comparing with a potentiometer the single electrode potentials of irradiated against unirradiated solutions, (*b*) by concentrating the ferric ion in a solution on an ion exchange column, and (*c*) by using aqueous solutions other than that proposed by Fricke. The potentiometer method is somewhat more difficult than that using the DU spectrophotometer and has not been exploited. The column concentration is successful, although in at least one case the resin in the column appears to cause a small amount of oxidation of ferrous to ferric ion. Most of our work to date is concerned with other solutions.

A cursory examination of many metal cations showed that iron exhibited the greatest sensitivity and it has been adopted throughout. To stabilize the system, additive chemicals have been sought which would form complexes both with ferrous and with ferric ions. Addition of inorganic anions generally produces a dosimeter not more sensitive than that of Fricke. Addition of organic acids can produce a dosimeter of greater or lesser sensitivity, apparently depending on the groups contained in the acid, as well as on spectral considerations. Some of these dosimeters also exhibit long-term stability. Our current standard has a G of 40 or so and has exhibited no observable change in the absence of irradiation since being mixed in June 1956. The composition is as follows: To 1 N H_2SO_4 add 7×10^{-4} molar benzoic acid and then 7×10^{-4} molar Fe^{+2} as $FeSO_4$. The optical density is read at 2715 Å.

Having stabilized the ferrous system, for example with benzoic acid, further additions of aliphatic organic acids can increase or decrease the sensitivity. Oxalic acid (1.5 gm./liter) gives a G $\sim$ 60. Tartaric acid (0.4 gm./liter) can give G $\sim$ 130 under suitable conditions. There appear to be drift considerations with systems investigated to date when G > 45.

Wavelengths of absorption and transmission, *p*H range to provide known complexing and to keep the iron from adhering to container walls, temperature control of solutions, and the kind of groups being added are all items of importance. Some insight is being gained as to the effect on sensitivity of some of the functional groups in the additive organic acids.

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Neutron-Insensitive Gamma-Ray Dosimeter[1]

R. S. CASWELL, Ph.D.

A gamma-ray dosimeter for mixed radiation dosimetry with a neutron sensitivity of ≤ 2 per cent (on the basis of absorbed dose in tissue) has been developed. This instrument consists of a graphite-wall, helium-CO_2-filled proportional counter operated at pressures of the order of 5–40 cm. Hg. Large pulses due to heavy particle recoils produced by neutrons, such as carbon recoils from the walls and helium recoils in the gas, are discarded. Small pulses due to secondary electrons produced by gamma rays are recorded and are weighted according to height (*i.e.*, according to the amount of current represented by each pulse) (1). The counter acts as a Bragg-Gray cavity, the "current" serving as a measure of the gamma-ray dose. Gamma-ray sensitivity is independent of energy to within ±20 per cent from 1.25 Mev (Co^{60}) to 47 kev. Some indication of the incident gamma-ray spectrum may be obtained from the gamma-ray pulse height distribution.

The counter container (outside the graphite lining) is made of thin aluminum to minimize production of gamma rays in the walls by inelastic scattering of the incident neutrons. Detection of these gamma rays by the counter represents neutron sensitivity, since the initiating particles are neutrons.

Tests were made with 2.5 Mev $H^2(d,n)He^3$ neutrons. The counter indicated an absorbed dose which was 2 per cent of the measured fast-neutron dose. This value is the sum of two contributions: (*a*) the gamma-ray contamination of the neutron radiation (the true gamma-ray dose) and (*b*) the neutron sensitivity of the dosimeter. Since we do not know the gamma-ray contamination of the neutron field, we obtain only an upper limit on the neutron sensitivity of the counter. Efforts are being made to decrease the gamma-ray contamination of the neutrons by redesigning the target assembly to minimize gamma-ray production by inelastic scattering.

This instrument operates at low dose rates (≤ 200 mrad/hr.), below the useful range of the gamma-ray

dosimeter of Sigoloff (2), which has been estimated to have comparably low neutron sensitivity.

The instrument could be adapted for survey meter use by including a "single-window" pulse-height analyzer to accept pulses in a fixed range of pulse heights.

This instrument is being used at the National Bureau of Standards in connection with an experiment to measure the neutron sensitivity of photographic film.

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[1] From the Radiation Physics Laboratory, National Bureau of Standards.

Theoretic Considerations of the Radiation Dose from Discrete Tritium Sources[1]

J. S. ROBERTSON M.D., Ph.D., and W. L. HUGHES

The preparation by one of us, (W. L. H.), of tritium-labeled thymidine of high specific activity permits the localizing of tritium within cell nuclei, and the question of the radiation dose from single tritium disintegrations assumes considerable practical importance. Tritium β^- particles have unusually low kinetic energies, the average being about 5.7 kev. Associated with this low energy is a short range, the figure usually cited being 0.23 mg./cm.^{2} as measured in helium gas (1), or about 2.3 μ in soft tissue. On this basis, the radiation dose from tritium sources localized in cell nuclei is delivered largely within the nuclei. The formulas for dose calculation which involve an assumption of homogeneous distribution are obviously not satisfactory for evaluation of the results in this situation. The formulas given by Loevinger (2) for the radiation dose from discrete sources also fail for tritium β^- particles. Therefore, the present calculations have been made.

The shape of the tritium β^- spectrum is well established (3, 4) and fits very closely a Fermi plot for the appropriate Z number and maximum energy. For present purposes, the spectrum was divided into eighteen 1-kev intervals, and the relative number of disintegrations in each interval was calculated.

Since none of the empirical formulas relating range and energy (5, 6) is satisfactory at these low energies, a smooth curve drawn through the published experimental values of ranges for monoergic electrons (7, 8) has been used. According to this curve, the maximum range of tritium β^- particles of maximum energy (18 kev) should be about 6 or 7 μ. The previously measured range of 2.3 μ corresponds to a maximum energy of only 9.5 kev. The straggling which occurs at these low energies, however, makes experimental determination of the range very difficult.

Differentiation of the range-energy curve gives the rate of loss of energy per unit path length and thus provides a basis for radiation dose calculations. Calculations based on the use of the Bethe-Block formula for the rate of energy loss along the path of electrons give fairly closely similar results.

Given the above basic information, the integrated energy loss in the volume surrounding a point source of tritium was calculated by multiplying the rate of energy loss by the average frequency of emission over 1-kev intervals as functions of distance at 0.5-μ intervals. Appropriate corrections for the volume factor and conversion from kev/μ^3 to rad gives the final curve of the average radiation dose rate as a function of distance from a point source. In the inner $^1/_2$ μ radius sphere (0.52 μ^3) a *single disintegration* gives an average of 53.5 rad (or about 2 rad per 10^{-6} μc-sec) while in the next $^1/_2$ μ shell (3.7 μ^3) the average dose is only 5.8 rad/dis. The 10 per cent of the total disintegrations having energies of 2 to 3 kev give an average of 82.5 rad per disintegration in the inner sphere. Even with the assumption of a 6-μ range, therefore, it is seen that the principal radiation dose is delivered within a sphere of 1-μ diameter. Consequently, tritium localized in cell nuclei, or even more discretely within chromosomes, should produce profound biological effects. Thymidine (combined in DNA) is normally present in cell nuclei in concentrations of 0.1 molar, and specific activities high enough to give 3 $\mu\mu$ curies of tritium (about 7 disintegrations per minute) within single nuclei appear to be possible. The high rate of linear energy transfer for electrons in the tritium energy range may be expected to augment biological effects further. RBE's of about 1.4 have been reported for homogeneously distributed tritium as judged by spleen and thymus atrophy (9).

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An Electronic Isodose Computer for Planning Multiportal Radiation Therapy, Featuring Instantaneous Display of Isodose Curves with Continuous Variability of Position and Fractional Dose in Each Field[1]

GLEN SANDBERG, B.S., and W. S. MOOS, Ph.D.

The procedures used heretofore to evaluate ionization dose distributions in multiportal irradiation are inaccurate or arduous and time-consuming, or too specialized and limited in application (1–4).

Our instrument uses optical projectors to superimpose images of radiation fields on a screen, producing an optical analogue of the radiation dose distribution in the plane under consideration, which is scanned by a television camera to produce electrical signals corresponding to the light levels on the screen. Electronic circuits are used to produce isodose curves on a monitor screen wherever the dose level equals a reference level.

Each radiation field is represented by a lantern-slide image which transmits light everywhere in proportion to the dose rate at the corresponding point in an appropriate phantom (5). The images of several fields are combined by projecting them onto a translucent screen from special projectors in which the slides are laid on horizontal stages to facilitate orientation. The resulting total illumination at each point of the screen is proportional to the total ionization dose at the corresponding point in the patient.

An industrial television camera is used to scan the translucent screen and change the illumination levels, representing radiation dose levels, into an electrical signal which is proportional to the brightness of each point of the screen as it is scanned. This signal is compared with a reference voltage which corresponds to a particular brightness level or dose rate, by means of a gate circuit which passes another signal whenever the video signal is within 0.1 volt of the reference level. The electron beam of the kinescope monitor tube, which scans the fluorescent screen of the tube in step with the scanning beam of the camera tube, is modulated by the output of the gate circuit. Whenever a point in the field is scanned which has a brightness representing a total dose equal to the reference level, a dark spot is produced at the corresponding point on the monitor screen. The locus of these points is an isodose curve.

At present five gate circuits are used, each with its adjustable reference level, to produce simultaneously the isodose curves corresponding to five different dose levels. These isodose curves adapt continuously to changes in position and fractional dose in the corresponding radiation field. The optimum arrangement is recorded by photographing the monitor screen.

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[1] From the Department of Radiology, College of Medicine, University of Illinois, Chicago, Ill.

Iodine-131 Beta Particle Dosage in Small Animals[1]

PATRICIA W. DURBIN, Ph.D., JAMES S. ROBERTSON, M.D., Ph.D.,[2] and JOSEPH G. HAMILTON, M.D.

Severe unrepaired radiation damage in the lymphatic tissues and the renal cortex of rats was observed one year after administration of I^{131} in amounts varying from 10 to 90 μc/gm. body weight. Other tissues also showed changes and these were attributed in part to irradiation (1). Calculation of whole-body radiation dosage based upon extrathyroidal distribution and excretion of tracer doses of I^{131} led to rather high values (greater than 800 rad at the 90 μc/gm. level, which is only slightly higher than the 60-day mean lethal dose for two-month-old Sprague-Dawley rats).

This report deals with a series of experiments designed to compare the distribution and excretion of tracer and toxic doses of I^{131} during the acute radiation period and to allow direct calculation of the radiation dosage in the individual organs and tissues.

Female Sprague-Dawley rats were injected intravenously with I^{131} in quantities ranging from the tracer dose, 1 μc/gm., to 90 μc/gm., at fifty-two to sixty days of age. Retention during the first three weeks was measured by whole-body *in vivo* counting with a pair of G-M tubes for which counting rates were adjusted by varying the tube-to-animal distance and by the use of suitable absorbers. Groups of rats at the 50 μc/gm. level were sacrificed at intervals varying from one hour to six days post-injection. Retention of I^{131} and tissue concentrations of I^{131} were determined. Radiation doses were calculated by graphical integration of the concentration *vs.* time curves, and appropriate corrections were made for radiation loss from the small organs. Autoradiographs were prepared from a number of tissues to determine localization.

Preliminary analysis of the data revealed the following:

1. At the tracer level, elimination was more rapid than at toxic levels. The elimination curves

were identical, however, for doses of 10 μc/gm. and above.

2. With the exception of the thyroid gland, tissue concentrations of I^{131} were greater by factors of more than two at the high dose levels.

3. Radiation dosages in individual tissues varied widely, ranging from 150 to 200 rad in muscle and ovary to 477 rad in spleen. These values agreed well with previous histological observations, mortality, and hematologic effects.

4. Autoradiographs indicated that the extrathyroidal I^{131} was associated in the main with the blood-vascular system.

5. Calculation of the radiation dose to the thyroid gland based on tracer measurements led to overly high values because of the extreme rapidity of release of I^{131} from the heavily irradiated gland.

A mathematical analysis of the special problem of radiation dosage to the gastrointestinal tract is currently under way.

REFERENCE

1. DURBIN, ASLING, JOHNSTON AND HAMILTON: Long-Term Sequelae of Massive Doses of I-131 in Rats. To be published.

[1] From the Division of Medical Physics and the Crocker Laboratory, University of California, Berkeley, Calif. This work was performed under the auspices of the U. S. Atomic Energy Commission.

[2] Brookhaven National Laboratory, Upton, N. Y.

Dose Distribution in Conical Rotation Therapy at 2 MeV[1]

WILLIAM ALAN JENNINGS, M.Sc., Ph.D., F.Inst.P., and ALICE L. McCREA, B.Sc.

Various moving-field therapy technics have been developed with a view to achieving optimum dosage distribution for particular patient needs. Conical rotation therapy, in which the patient lies on a horizontal rotating cot under a fixed inclined beam, was first developed for units operating at 200-250 kV and later extended to 2 MeV radiations from a Van de Graaff generator, at the Royal Cancer Hospital in London, by Wheatley, Steed, et al. (1953).

In order to preserve the skin-sparing effect with this quality of radiation, the London group did not use a surface wax cone to counteract the otherwise oblique entry of the beam, but aimed the beam axis deep to the lesion, so that the zone of maximum dosage lay around the lesion center, whether one- or two-sided irradiations were delivered. This entails the use of a relatively broad beam in relation to the treatment volume, and the steep angle of entry tends to raise the exit dose. In consequence, the percentage depth dose and rate of fall of dosage outside the treatment zone were thought to leave room for improvement.

An alternative approach consists in using a wax cone on the surface of the patient so that the inclined beam is directed perpendicularly to the cone surface. This will reduce the rate of fall in dose level along the rotation axis, and the beam may be aimed directly at the lesion center, providing irradiation is carried out from both sides. A number of further advantages in relation to the alternative technic may also be claimed.

1. The cone can be placed on a Lucite compressor plate which provides an accurate and repeatable patient set-up.

2. The standard isodose charts, when placed on a scale drawing of the set-up, provide axial dose rates directly, as these do not vary during rotation.

3. Smaller beams, a little greater than the diameter of the lesion, may be used.

4. The dose is more uniform throughout the volume of the lesion and falls off more rapidly outside it.

5. Percentage depth doses are greater in spite of the loss of the entrance skin-sparing effect.

Dose distributions, measured by film densitometry, and checked in both phantoms and patients by micro-ionization chamber measurements, demonstrate that the 80 per cent dose contour approximates the beam diameter at the chosen depth.

[1] From the Argonne Cancer Research Hospital and the Department of Radiology, The University of Chicago, Chicago, Ill.

Electron Beam Dosimetry of a 2-Mev Van de Graaff Accelerator[1]

B. W. SHUMWAY, B.S., and R. GOLDEN, B.A.

The electron beam of a 2-Mev Van de Graaff accelerator has been investigated with a shallow ionization chamber and with film, over the energy range of 0.6 to 2.0 Mev. Measurements of the intensity along the beam axis were made as a function of distance from window to detector. Beam width as a function of energy and distance from the window was determined by the blackening produced in sheet film in a plane perpendicular to the central axis of the beam. The angular distribution of electrons about the axis was found to be nearly gaussian as predicted by small-angle scattering theory. This theory further predicts the mean square scattering angle to be approximately inversely proportional to the energy squared. Consequently, the electron intensity should be proportional to the square of the electron energy. This was tested using an ionization chamber at 1 meter, and good agreement was obtained over the entire energy region. Since the specific ionization is nearly constant over this energy range, the dose measured is proportional to the fraction of the total electrons intercepted by the chamber. Electron

depth dose studies were made with the ionization chamber. Tracing paper was used as approximately tissue-equivalent material. At 1.0 Mev the depth dose shows a build-up to a maximum at a depth of 135 mg./cm.^{2} and attenuation to 50 per cent of maximum at 270 mg./cm^2.

[1] From the U. S. Naval Radiological Defense Laboratory.

Analysis of the Cs^{137} Content in Man Due to Radioactive Fallout[1]

C. E. MILLER, Ph.D., L. D., MARINELLI, M.A., and O. J. STEINGRABER

On Sept. 30, 1955, the gamma-ray scintillation spectra of 12 normal, healthy, unexposed persons were rigorously analyzed and their normal body K content was calculated by using experimentally determined *in vivo* K spectra in our low-level gamma-ray counting facility. This analysis demonstrated that some individuals contained small body burdens of another radioactive isotope which was tentatively identified as, and subsequently proved by urinalyses to be, the fission product Cs^{137}. A re-examination of the data accumulated at the time proved sufficient to obtain reliable information on four subjects dating as far back as June 30, 1955.

The normal body K and Cs^{137} burdens of 12 control subjects have been followed since Sept. 30, 1955. All control subjects demonstrated an increase in Cs levels of from 60 to 120 per cent between Oct. 10, 1955, and Feb. 13, 1956. The maximum variation in any individual's own Cs level from February 1956 to the present time has been less than 6 per cent. On the other hand, the K contents have not changed over the past eighteen months.

In addition, the Cs and K levels of approximately 150 persons, of whom at least 25 were from countries outside the United States, have been determined in the past year. The gamma-ray spectra of persons from all parts of the world have been analyzed. The amount of Cs present bears no relation to the location of the native country, but follows essentially the subject's intake of milk, cheese, and meat; this correlation was first observed in the control group. The body burdens of cesium vary from 3×10^{-9} curies for a non-milk drinking meat-eater up to 9×10^{-9} curies for a person who ingests copious quantities of both. A biological half-time of the order of 100 days has been found for Cs.

Different food products have been assayed for radioactivity, and, to date, only milk, cheese, and meat have been found to contain cesium.

Samples of rug dirt from domestic vacuum sweepers have been collected from various points within the United States. These samples have an activity approaching 10^{-8} curies, and the spectrum reflects the time elapsed between preceding nuclear detonations and sample collection.

[1] From the Radiological Physics Division, Argonne National Laboratory, Lemont, Ill. Work performed under the auspices of the Atomic Energy Commission.

EDITORIAL

Summaries in Interlingua

With the new year, RADIOLOGY is instituting a slight change of policy with the object of making its contents available, at least in summary, to a much wider audience. Beginning with the present issue, each of the main articles will be summarized in Interlingua, the recently developed international or "supranational" language that has already been adopted by a number of leading scientific journals for a similar purpose.

While this will mean a discontinuance of the Spanish summaries that have appeared in RADIOLOGY over the past eight years, our Spanish readers will actually suffer no loss, since they will unquestionably find Interlingua as intelligible as their own tongue. It has the added advantage of being readable by the vast majority of those familiar with French, Italian, Portuguese, or German.

There can be no dispute as to the universality of science, including that of radiology. Scientific publications, however, have not shared in this quality, and language differences have proved a barrier to the wide dissemination of information which has seemed desirable. Various European periodicals have sought to overcome this difficulty by publishing summaries in several languages, and a few American journals have followed suit, though to a limited extent.

The need for a single wider means of communication is attested by the fact that since the last century the number of international languages proposed or attempted is in the hundreds. With few exceptions, these have found no wide following. The difficulties encountered in their use appear to be largely overcome by Interlingua, the elements of which are common to the principal languages of the Western world.

Actually Interlingua is the result of an intensive study on the part of the International Auxiliary Language Association, which is an outgrowth of investigations of the auxiliary language problem undertaken after the First World War by committees of the International Research Council, by the British, French, Italian, and American Associations for the Advancement of Science, the American Council on Education, the American Council of Learned Societies, and other groups.

The vocabulary is drawn mainly from languages having a common Latin basis —French, Italian, Spanish, English, and Portuguese—though the definite characteristics of the individual languages have been eliminated in determining the international forms. This point and others are explained at length in the Interlingua-English Dictionary prepared by the International Auxiliary Language Association.[1] No dictionary will be found necessary, however, for an understanding of the Summaries.

As with the Spanish summaries, it will remain our policy to convey the actual points made by the author in the original rather than simply indicating what the article contains.

With this brief statement we commend to our readers this further effort to increase the usefulness of RADIOLOGY as a working tool of our specialty.

[1] Interlingua-English, A Dictionary of the International Language Prepared by the Research Staff of the International Auxiliary Language Association, under the direction of Alexander Gode, Ph.D. New York, Storm Publishers, 1951.

Summarios in Interlingua

Con le nove anno, RADIOLOGY institue un leve modification de su methodos con le objectivo de render su contento accessibile, al minus in forma de summario, a un multo plus extense lectorato. Comenciante con le presente numero, omne articulo principal va esser summarisate in interlingua, le recentemente disveloppate lingua international o "supranational" que ha jam essite adoptate per un numero de eminente jornales scientific pro simile objectivos.

Ben que isto significa le discontinuation del summarios espaniol que ha apparite in RADIOLOGY durante le passate octo annos, nostre lectores de lingua espaniol va non de facto suffrer ulle perdita, proque illes va sin dubita trovar interlingua tanto intelligible como lor lingua materne. In plus interlingua ha le avantage de esser comprensibile al vaste majoritate del lectores qui es familiar con francese, italiano, portugese, o germano.

Le universalitate del scientias, incluse le scientia radiologic, es foras de controversia. Sed le publicationes scientific non participa in iste qualitate, e differentias de lingua ha agite como barrieras al libere dissemination de informationes que es urgentemente desirate. Varie periodicos europee ha tentate superar iste difficultate per publicar summarios in plure linguas, e un certe, ben que restringite numero de jornales american ha sequite lor exemplo.

Le desirabilitate de un unic e plus comprehensive medio de communication es reflectite in le facto que depost le passate seculo le numero de projectos o proponimentos de linguas international ha attingite plure centenas. Con pauc exceptiones, iste tentativas non ha trovate multe adherentes. Le difficultates incontrate in lor application es apparentemente resolvite in grande mesura in le caso de interlingua que consiste de elementos commun al principal linguas occidental.

De facto, interlingua es le resultato de un intense studio del parte del Association de Lingua Auxiliar International que esseva un fundation inspirate per le investigationes del problema de lingua auxiliar interprendite post le prime Guerra Mundial per committees del Consilio International de Recercas, per le Britannic, Francese, Italian, e American Associationes pro le Avantiamento del Scientia, per le Consilio American de Pedagogia, le Consilio American de Societates Erudite, e altere gruppos.

Le vocabulario es derivate principalmente ab linguas que possede un commun base latin—francese, italiano, espaniol, anglese, e portuguese—ben que le characteristicas specific del linguas individual esseva eliminate in le determination del formas international. Iste puncto es explicate inter alteres in le Dictionario Interlingua-Anglese preparate per le Association de Lingua Auxiliar International.[1] Tamen, nulle dictionario es requirite pro le comprension del summarios.

Como in le caso del summarios espaniol, il va remaner nostre objectivo presentar le constatationes mesme que le autor ha presentate in su texto original e non simplemente indicar lo que le articulo contine.

Con iste breve commentario nos sollicita le bon voluntate de nostre lectores pro iste nove effortio de augmentar le utilitate de RADIOLOGY como utensile in le arsenal de nostre disciplina.

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[1] Interlingua-English, A Dictionary of the International Language Prepared by the Research Staff of the International Auxiliary Language Association, under the direction of Alexander Gode, Ph.D. New York, Storm Publishers, 1951.

ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN BOARD OF RADIOLOGY EXAMINATION FOR CERTIFICATION IN NUCLEAR MEDICINE

Within the very near future, a special examination for certification in Nuclear Medicine will be offered to diplomates in Radiology and Therapeutic Radiology. Those interested must apply to the American Board of Radiology, Kahler Hotel Building, Rochester, Minn., before Feb. 15, 1957.

B. R. Kirklin, M.D.
Secretary

AMERICAN COLLEGE OF RADIOLOGY

The regular Annual Meeting of the American College of Radiology will be held Friday, Feb. 8, at the Drake Hotel, Chicago, Ill. Members and Fellows are cordially invited to attend a luncheon to be given at the Hotel on Friday, and the Convocation and Banquet that evening. The Annual Teachers' Conference meets the following day.

At the Banquet, the Gold Medal of the College will be awarded to two distinguished radiologists, Dr. Robert R. Newell and Dr. Hollis E. Potter.

EASTERN CONFERENCE OF RADIOLOGISTS

The Eastern Conference of Radiologists is to be held at the Waldorf Astoria Hotel, New York City, March 7–9, 1957. Invitation is extended to all radiologists and their families to attend the Conference. A theater party has been arranged for Thursday evening, March 7, following the traditional cocktail party. The price of tickets is: Mezzanine $5.75; Orchestra $7.50 and $6.25.

Among papers to be presented are the following: Influence of Vascularization, Lymphatic Drainage, and Movement on the Behavior of Cancer, by Maurice Lenz, M.D.; Irradiation Followed by Hysterectomy and Lymphadenectomy in Cancer of Cervix, by Harry W. Burnett, M.D.; Radiologic Appearance of Peripelvic Cysts of the Kidney, by Wm. Dubilier, Jr., M.D., and John A. Evans, M.D.; Simultaneous Intravenous Cholangiography and Urography, by Wm. H. Shehadi, M.D.; Diaphragmatic Roentgen Kymographic Manifestations of Liver Metastases, by Bernard S. Epstein, M.D.; Vertebral Pedicle Sign: A Roentgen Finding to Differentiate Metastatic Carcinoma from Multiple Myeloma, by Harold G. Jacobson, M.D., Maxwell H. Poppel, M.D., Jerome H. Shapiro, M.D., and Samuel Grossberger, M.D.; Special Technics of Value in Orthopedic Radiography, by Maurice M. Pomeranz, M.D.; Supervoltage Rotation Therapy for Cancer of the Head and Neck, by Milton Friedman, M.D.; Supervoltage Irradiation of Multiple Primary Lesions in the Head and Neck, by Ruth J. Guttmann, M.D.; Use of the Rad in Radiation Therapy, by John H. Laughlin, Ph.D.; Transit Exposure System for Co^{60} Rotating Teletherapy, by Carl B. Braestrup, George Hertsch, and Richard T. Mooney; Recent Advances in Use of Radioyttrium, by H. C. Dudley, Ph.D., and Joseph Greenberg, M.D.

Two Symposia are scheduled: one on the Treatment of Recurrent Carcinoma of the Cervix, with Dr. James J. Nickson as Moderator and Alexander Brunschwig, M.D., Wm. M. Daniel, M.D., Leonard Liegner, M.D., and James Palmer, M.D., as Panelists; the other on Cystic Fibrosis of the Pancreas, with Dr. John Caffey as Moderator and Dorothy Anderson, M.D., Paul di Sant'Agnese, M.D., Wm. Blanc, M.D., and Robert Hiatt, M.D., forming the Panel.

Dr. Sidney Rubenfeld, President of the New York Roentgen Society, is Chairman of the Conference.

The registration fee for physicians and visitors will be $25.00. The fee for wives and guests will be $15.00. Checks covering registration fees and theater tickets should be mailed to Dr. Harold G. Jacobson, Treasurer, Department of Radiology, Montefiore Hospital, 210th St. and Bainbridge Ave., New York, N. Y.

RADIOLOGICAL SOCIETY OF GREATER CINCINNATI

Officers of the Radiological Society of Greater Cincinnati for the coming year are as follows: President, Dr. Richard J. Neubauer, Cincinnati; Vice-President, Dr. Roland Wintzinger, Cincinnati; Secretary-Treasurer, Dr. Morris M. Garrett, 630 Scott St., Covington, Ky.

COLORADO RADIOLOGICAL SOCIETY

Officers elected by the Colorado Radiological Society to serve during 1956–57 are: Gerald S. Maresh, M.D., Denver, President; James Lewis, M.D., Colorado Springs, Vice-President; Lorenz R. Wurtzebach, M.D., 601 E. Nineteenth Ave., Denver 5, Colo., Secretary; Charles Gaylord, M.D., Denver, Treasurer.

NASSAU (N. Y.) RADIOLOGICAL SOCIETY

New officers of the Nassau Radiological Society are as follows: President, Arthur Frucht, M.D., Hempstead; Vice-President, Benjamin Feuerstein, M.D., Bay Shore; Treasurer, John Knapp, M.D., Hempstead; Secretary, Jerome Zwanger, M.D., 126 Hicksville Road, Massapequa, L. I., N. Y., Secretary; members of the Executive Committee, Kenneth Horne, M.D., East Hampton, and Seymour Wasserman, M.D., Bay Shore.

WISCONSIN RADIOLOGICAL SOCIETY

At a recent meeting of the Wisconsin Radiological Society, the following officers were elected for the ensuing year: President, Dr. L. W. Paul, Madison; President-Elect, Dr. W. W. Moir, Sheboygan; Secretary-Treasurer, Dr. Farrell F. Golden, 5221 Tonyawatha Trail, Madison 4, Wisc.

COURSE IN THE CLINICAL USE OF RADIOACTIVE ISOTOPES

A course in the clinical use of radioactive isotopes will be given by Dr. Sergei Feitelberg of Mount Sinai Hospital, New York, and Dr. Edith H. Quimby of Columbia University, June 3 through June 28, 1957, Mondays through Fridays, 9 to 12 A.M. and 1 to 5 P.M.

This is a full-time course, including lectures, clinical rounds, and experimental laboratory exercises, as well as clinical laboratory measurements on patients and on specimens. In addition to the listed instructors, sixteen invited lecturers from the New York area will present topics in their special fields.

The *lectures* will cover the physics of radioactive isotopes and of interaction of radiation and matter; technic and measurements of radiation and of radioactive isotopes; the clinical use of radioactive iodine in thyroid disease; the therapeutic use of radioactive phosphorus and radioactive gold; the diagnostic use of miscellaneous isotopes (determination of blood volume, localization of brain tumors, radioactive sodium, and radioactive iron); and the organization of radioisotope work in a hospital.

Laboratory work will comprise thirteen afternoon sessions devoted to experiments on basic methods of radioisotope measurements, on technics used in clinical diagnostic work, and experience with equipment actually employed in clinical procedures.

The class is limited to twenty; the fee for the course is $250. Inquiries may be addressed to Dr. Edith H. Quimby, Radiological Research Laboratory, 630 West 168th St., New York 32.

COURSE IN RADIOLOGY AND RADIOACTIVE ISOTOPES, UNIVERSITY OF KANSAS

The postgraduate course in Radiology and Radioactive Isotopes, offered annually by the University of Kansas School of Medicine, will be held Feb. 11-14, 1957, with a guest faculty of national reputation. Major emphasis will be given to diagnostic radiology, with one day devoted to radiation therapy and one day to radioactive isotopes. While planned primarily for the radiologist, the course is open to any doctor of medicine interested in radiology, in its various phases.

A fee of $45.00 is charged to help cover the program and administrative costs. Partial enrollment is accepted for one, two, or three days, at $13.50, $25.00, and $35.00 respectively. All communications should be addressed to the Department of Postgraduate Medical Education, University of Kansas School of Medicine, Kansas City 12, Kans., and checks should be made payable to the University of Kansas.

FOURTH CONGRESS OF RADIOLOGY AND ELECTROLOGY OF LATIN CULTURE

The Fourth Congress of Radiology and Electrology of Latin Culture will be held in Lisbon April 8–13, including sections on Radiobiology, Radiodiagnostics, Radiotherapy, Nuclear Medicine, Electrology, and Physiotherapy. Further details may be obtained from Dr. Manuel Côrte Real, Secretary of the Congress, Avenida Duque de Loulé, 74-1°, Lisbon, Portugal.

DR. JOHN CAFFEY HONORED

Dr. John Caffey, of the Columbia-Presbyterian Medical Center, New York City, was chosen to deliver the Mackenzie Davidson Memorial Lecture and receive the medal and award of the British Institute of Radiology at its Annual Meeting in London, Dec. 6th and 7th.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

ROENTGEN SIGNS IN CLINICAL DIAGNOSIS. By ISADORE MESCHAN, M.A., M.D., Professor and Director of Radiology, Bowman Gray School of Medicine of Wake Forest College, Winston-Salem, N. C.; Formerly Professor and Head of the Department of Radiology at the University of Arkansas School of Medicine, Little Rock, Ark. With the assistance of R.M.F. FARRER-MESCHAN, M.B., B.S. (Melbourne, Australia). A volume of 1,058 pages, with 2,216 illustrations including roentgenograms. Published by W. B. Saunders Co., Philadelphia & London, 1956. Price $20.00.

ATLAS OF TUMORS OF THE NERVOUS SYSTEM. By H. M. ZIMMERMAN, M.D., Chief, Laboratory Division, Montefiore Hospital, and Professor of Pathology, College of Physicians and Surgeons, Columbia University, New York City; MARTIN G. NETSKY, M.D., Associate Neuropathologist and Associate Attending Physician in Neuropsychiatry, Montefiore Hospital, New York City, presently Professor of Neuropathology and Associate Professor of Neurology, Bowman Gray School of Medicine of Wake Forest College, Winston-Salem, N. C.; LEO M. DAVIDOFF, M.D., At-

tending Neurological Surgeon, Montefiore Hospital, and Professor and Chairman, Department of Surgery, Albert Einstein College of Medicine, New York City. A volume of 192 pages, with 277 illustrations including roentgenograms, photographs, photomicrographs, and drawings (233 in color). Published by Lea & Febiger, Philadelphia, 1956. Price $25.00.

RADIOLOGY OF THE ALIMENTARY TRACT IN INFANCY. By ROY ASTLEY, M.B., M.R.C.S., D.M.R., Radiologist, The Children's Hospital, Birmingham (United Birmingham Hospitals), England; Clinical Lecturer in Radiology and Lecturer in Radiological Anatomy, University of Birmingham. A volume of 288 pages, with figures, tables, and numerous roentgenograms. Published by Edward Arnold Ltd., London, and Williams & Wilkins Co., Baltimore, 1956. Price $10.00.

ADVANCES IN CANCER RESEARCH. Volume IV. Edited by JESSE P. GREENSTEIN, National Cancer Institute, National Institutes of Health, U. S. Public Health Service, Bethesda, Md., and ALEXANDER HADDOW, Chester Beatty Research Institute, Royal Cancer Hospital, London, England. A volume of 416 pages, with tables and graphs. Published by Academic Press Inc., New York, 1956. Price $10.00.

PROGRESS IN NUCLEAR ENERGY. SERIES VI, BIOLOGICAL SCIENCES. Volume I. Edited by J. C. BUGHER, The Rockefeller Foundation, New York; J. COURSAGET, C.E.A., Saclay; and J. F. LOUTIT, Medical Research Council A.E.R.E., Harwell. A volume of 206 pages, with numerous illustrations including autoradiograms, graphs, photographs, and tables. Published by McGraw-Hill Book Co., New York, and Pergamon Press Ltd., London, 1956. Price $7.00.

PROGRESS IN NUCLEAR ENERGY. SERIES VII, MEDICAL SCIENCES. Volume I. Edited by J. C. BUGHER, The Rockefeller Foundation, New York; J. COURSAGET, C.E.A., Saclay; and J. F. LOUTIT, Medical Research Council, A.E.R.E., Harwell. A volume of 166 pages, with tables. Published by McGraw-Hill Book Co., Inc., New York, and Pergamon Press Ltd., London, 1956. Price $6.00.

THE MERCK MANUAL OF DIAGNOSIS AND THERAPY. Ninth Edition. Editorial Board: CHARLES E. LYGHT, M.D., Editor, WILLIAM P. BOGER, M.D., GEORGE A. CARDEN, M.D., AUGUSTUS GIBSON, M.D., and DICKINSON W. RICHARDS, M.D. A volume of 1,870 pages. Published by Merck & Co., Inc., Rahway, N. J., 1956. Price $6.75.

LE DIAGNOSTIC DU CANCER D'ESTOMAC A LA PÉRIODE UTILE. By RENÉ A. GUTMANN, Collège de Médecine des Hôpitaux de Paris. A monograph of 260 pages, with 104 diagrammatic drawings in the text and over 300 figures included in 90 plates. Published by G. Doin & Cie, 8, Place de l'Odéon, Paris-VI^e, 1956. Price 4,300 fr.

ÉTUDES SUR LA PRÉCISION EN RADIODIAGNOSTIC. TECHNIQUES D'UN NOUVEAU CRANIOGRAPHE. NOTATION ANGULAIRE DE L'INCIDENCE. By G. L. DULAC, Ancien Chef de Service à la Fondation Curie. With a preface by M. Bouchet, Otorhino-laryngologiste honoraire des Hôpitaux de Paris. A monograph of 134 pages, with 47 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris-6^e, 1956. Price 1,300 fr.

ACTION DES RADIATIONS IONISANTES SUR L'ORGANISME. By A. LACASSAGNE, Professeur honoraire au Collège de France, Directeur honoraire de l'Institut du radium (sections biologique et thérapeutique), and G. GRICOUROFF, Chef du Service d'Histopathologie de la Fondation Curie (Institut du radium del' Université de Paris). A monograph of 198 pages, with 17 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris-6^e. Second edition, completely revised, 1956. Price 1,500 fr.

DIAGNOSTIC DIFFÉRENTIEL RADIOLOGIQUE DES ULCÉRATIONS GASTRIQUES. By GEORGES CANDARDJIS. With prefaces by Dr. P. Porcher and Pr. L. Babaïantz. A monograph of 188 pages, with 92 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris-6^e, 1956. Price 1,500 fr.

LA RADIOLOGIE CLINIQUE DE L'OESOPHAGE. By MARCEL BROMBART, Chef du Service de Radiodiagnostic à la Clinique César de Paepe, Bruxelles. With a preface by Pr. Ch. Auguste and an introduction by Pr. L. Deloyers. A volume of 466 pages, with 337 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris-6^e, 1956. Price 4,400 fr., paper; 5,000 fr., cloth.

TECHNIC DU RADIODIAGNOSTIC. By J. GARCIA-CALDÉRON AND G. LEDOUX-LEBARD. A volume of 1,148 pages, with 746 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris-6^e. Second enlarged edition, 1956. Price 7,000 fr., paper; 7,800 fr., cloth.

STRAHLENDOSIS UND STRAHLENWIRKUNG. TAFELN UND ERLÄUTERUNGEN; UNTERLAGEN FÜR DEN STRAHLENSCHUTZ. By B. RAJEWSKY, with the collaboration of K. AURAND, O. HUG, H. MERGLER, H. MUTH, H PAULY, A. SCHRAUB, E. SIX, AND I. WOLF, Max-Planck-Institut für Biophysik, Frankfurt a. M. A volume of 486 pages, including

numerous graphs and tables. Published by Georg Thieme, Stuttgart, 2d ed., 1956. Distributed in the United States and Canada by the Intercontinental Medical Book Corp., New York 16, N. Y. Price DM 36.—($8.60).

MEDIZINISCHE RÖNTGENTECHNIK. LEHRBUCH FÜR MEDIZINISCH-TECHNISCHE ASSISTENTINNEN, ARTZE UND STUDIERENDE, IN ZWEI TEILEN. MEDIZINISCHER TEIL: SKELETTAUFNAHMEN UND ORGANUNTERSUCHUNGEN. By Prof. Dr. HERBERT SCHOEN, Karlsruhe, with the assistance of Dr. DETLEV SCHOEN, Marburg/Lahn. A volume of 348 pages, with 537 illustrations. Published by Georg Thieme, Stuttgart. Second enlarged edition, 1956. Distributed in the United States and Canada by the Intercontinental Medical Book Corp., New York 16, N. Y. Price DM 29.70.—($7.00).

DIE RÖNTGEN-UNTERSUCHUNG DES HERZENS UND DER GROSSEN GEFÄSSE. VÖRTRAGE DES I. BONNER RÖNTGENOLOGISCHEN WOCHENENDKURSUS. By R. JANKER, F. GROSSE-BROCKHOFF, R. HAUBRICH, H. LOTZKES, A. SCHAEDE, AND H. HALLERBACH. A volume of 230 pages, with 249 illustrations. Published by W. Girardet, Wuppertal, Germany, 1955. Price $8.75.

Book Reviews

THE SPINE. ANATOMICO-RADIOGRAPHIC STUDIES. DEVELOPMENT AND THE CERVICAL REGION. By LEE A. HADLEY, M.D., Senior Attending Roentgenologist, Syracuse Memorial Hospital; Clinical Associate Professor of Public Health, New York State College of Medicine; Consultant in Radiology, Syracuse State School, Syracuse, N. Y. A volume of 156 pages, with numerous illustrations. Published by Charles C Thomas, Springfield, Ill., 1956. Price $6.50.

The limited scope of this monograph is indicated by the subtitle. The first two chapters deal with the development of the spine in the pre- and postnatal period and the departures from normal which may occur in this process, such as agenesis, disordered segmentation, lack of fusion, etc. The three remaining chapters are devoted to the cervical spine, covering congenital anomalies, injuries, arthritis, and secondary degenerative changes in the vertebrae and disks.

The text is profusely illustrated with roentgenograms, photomicrographs, and photographs. A pertinent bibliography is appended to each chapter.

AN ATLAS OF TUMOR PATHOLOGY. Published by the Armed Forces Institute of Pathology, under the auspices of the Subcommittee on Oncology of the Committee on Pathology of the National Research Council, Washington, D. C. For sale by the American Registry of Pathology, Washington 25, D. C.

TUMORS OF THE THYMUS GLAND. By BENJAMIN CASTLEMAN, M.D., Chief, Department of Pathology and Bacteriology, Massachusetts General Hospital, Clinical Professor of Pathology, Harvard Medical School, Boston, Mass. A volume of 82 pages with 81 black and white illustrations and 4 colored plates, 1955. Price $1.00.

This is one of a long and outstanding list of fascicles concerning tumors of various organs or systems published by the Armed Forces Institute of Pathology of the United States under the auspices of the National Research Council, which together will comprise a sorely needed atlas of tumor pathology. For this, as for the other publications in the series, the author has been selected because of his particular interest in the field. The brevity of the text is offset by the completeness of the discussion and the picturization of the normal and hyperplastic thymus, the thymus in myasthenia gravis, thymoma, tumors resembling thymoma, and other tumors of the thymus gland. Although the work is of primary interest to the pathologist, the radiologist should be aware of the availability, not only of this particular volume, but of the remainder of the series.

TUMORS OF THE CARDIOVASCULAR SYSTEM. By BENJAMIN H. LANDING, M.D., Pathologist, The Children's Hospital, Cincinnati, Ohio, and SIDNEY FARBER, M.D., Professor of Pathology, Harvard Medical School, Pathologist at the Children's Hospital, Boston, Mass. A volume of 138 pages with 138 black and white illustrations.

In this work the section on tumors of the heart is of interest not only because of the changes in roentgenographic cardiac contour produced by such lesions but because of their occasional demonstrability by angiocardiography and pneumopericardiography.

The section on tumors of blood vessels serves as a reference for the many rare eponymic classifications in this field.

TUMORS OF THE FEMALE SEX ORGANS. PART I. HYDATIDIFORM MOLE AND CHORIOCARCINOMA. By ARTHUR T. HERTIG, M.D., Professor of Pathological Anatomy, Harvard Medical School, Boston, Mass., and HAZEL MANSELL, M.B., B.S., Instructor in Pathology, Harvard Medical School. A volume of 63 pages, with 65 black and white illustrations and 2 colored plates.

The title is descriptive of the material covered in this authoritative work.

CONTRIBUTION À L'ÉTUDE DU SYNDROME ENDOCRINIEN PROVOQUÉ PAR L'IRRADIATION TOTALE DE L'ORGANISME. By E. H. BETZ, Chef de

Travaux a l'Université de Liège, Associé du Fonds National de la Recherche Scientifique. Preface by Robert Courrier, Secrétaire perpétuel de l'Académie des Sciences, Professeur au Collège de France. A volume of 326 pages, with 71 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris-6°. Price 2,800 fr.

The development of nuclear weapons has prompted many investigations into the circumstances leading to, and the actual cause of, death from irradiation, in the hope that a way may be found to avert the fatal outcome. When total-body irradiation of animals results in death after ten to fifteen days, the cause is usually an association of several factors, among which are the destruction of hematopoietic tissue, the hemorrhagic tendency, and supervening infection. This volume is an account of extensive experimentation to determine whether the endocrine disturbances incident to total-body irradiation can influence the animal's resistance and/or the regeneration of hematopoietic organs.

It was first established that resistance to radiation is influenced not as much by the extent of destruction achieved as by the body's capacity to repair the damage. In the rat, it was found that a lethal dose of total-body irradiation (800 r) will increase the activity of the adrenal cortex, will decrease the activity of the thyroid, but will not affect the gonads (these are the only three endocrine glands evaluated in this study).

According to the author's hypothesis, lethal radiation leads to a serious endocrine imbalance, with hypersecretion of corticosteroids and hypothyroidism, and to the disappearance of certain unknown factors necessary for the metabolism of nucleoproteins, the lack of which inhibits hematopoietic regeneration. There are substances with protective action (cysteine, cystamine, KCN, thiourea, etc.) but the mechanism by which they act is not well known.

The text is in fact a logbook of the various procedures employed (the experiments were performed in the Laboratories of Pathological Anatomy of the University of Liège, Belgium), but adequate space is given to the literature, as proved by twenty-one pages of bibliography, and each of the nine chapters ends with a summary and interpretative discussion of the respective results.

The monograph is a valuable contribution and it is recommended to those interested in the field. They will be able to make good use of its factual content, and may even enjoy the hypotheses offered as stepping stones for future research.

HÄMODYNAMIC DES HERZENS IM RÖNTGENBILD MIT BESONDERER BERÜCKSICHTIGUNG DER HERZKATHETERISIERUNG UND DER ANGIOKARDIOGRAPHIE. Fortschr. a. d., Geb. d. Röntgenstrahlen. Ergänzungsband 76. By Dr. P. THURN, Priv.-Doz. an der Universität Bonn. Foreword by Prof. Dr. Paul Martini, Bonn. A volume of 168 pages, with 81 illustrations. Published by Georg Thieme, Stuttgart, 1956. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 48.—($11.40).

This work is based on an extensive personal experience in the examination of 300 patients with acquired and 1,200 with congenital heart disease. It gives a concise approach to the problems—especially the limitations—of interpretation of conventional heart roentgenograms and evaluates the roentgen characteristics on the basis of corroborative catheterization, angiocardiography, kymography, and surgery.

After a short preface and introduction, the author considers successively physiopathologic factors, the size of the heart on the conventional roentgenogram, and evaluation of the size of the cardiac chambers by catheterization and by angiocardiography. He discusses in detail the right ventricle and various pathologic factors influencing it, the left ventricle, and the combined cardiac anomalies involving both right and left ventricles. There follow a discussion and summation of the conventional roentgen findings seen in various cardiac conditions which might aid in arriving at a diagnosis. Both the simpler and more complex cardiac disorders and their differential diagnosis are analyzed. The author dwells at length on the hemodynamic changes and pathophysiologic factors influencing the roentgen patterns encountered in different conditions and discusses the evaluation and interpretation of the cardiovascular roentgenograms with respect to differences in measurements, size, shape, and position of the cardiac and vascular contours. The later chapters deal with enlargements of the right and left auricles, the great vessels—aorta and pulmonary vessels—the kymographic evaluation of primary and transmitted pulsations, and postoperative changes. An extensive bibliography is supplied.

In various chapters the author considers specific hemodynamic and pathophysiologic factors influencing the cardiovascular pattern and producing changes in roentgenograms in a given case. The book contains excellent conventional roentgenograms, as well as angiocardiograms, kymograms and films of the heart with the catheter *in situ*. To the various roentgenograms and case histories information as to the numerical pressures at the tip of the catheter and blood flow data are added. This concise book should be of interest to the radiologist and cardiologist whose knowledge of these problems is not yet too advanced.

STRATITERAPIA BIFOCALE. By G. TORI, G. BRUSORI, R. MICELI, AND E. ZAFFAGNINI. Foreword by Prof. G. G. Palmieri, Instituti de Radiologia e del Radio dell'Università di Bologna. A mono-

graph of 146 pages, with 59 figures and 3 tables. Published by L. Cappelli, Bologna, 1956.

This monograph is an exposition of the principles of bifocal stratitherapy as evolved by Palmieri at the University of Bologna.

The usual method of irradiating tumors by cross-firing results in conditions of "spatial and temporal discontinuity." This accounts at least in part for some of the failures in conventional irradiation. Palmieri's principle of chronotopic (space and time) homogeneity is designed to avoid these shortcomings of conventional irradiation. By two opposing and moving tube heads, focused over the region of interest, an identical dose can be delivered to all the tumor at the same time, avoiding both over- and under-dosage and the effects of differential recovery of the cells. These principles are adequately explained in this text, which also describes the apparatus, and outlines the general indications, clinical aspects, and dosimetry.

NORME PER LE PROTEZIONI CONTRO LE RADIAZIONI IONIZZANTI. Prepared by F. FOSSATI, P. GALLONE, L. PARMEGGIANI, C. POLVANI, AND M. SCOLARI. With a preface by Prof. L. Turano, Direttore dell'Instituto di Radiologia dell'Università di Roma, *Presidente*, Comitato per le Protezioni Radiologiche, Società Italiana di Radiologia Medica. A volume of 260 pages, with 22 figures and 39 tables. Published by Ulrico Hoepli, Milan, 1956.

This work on protection against ionizing radiations appears under the auspices of the Italian Society of Medical Radiology and is the standard for that country. The text consists of an introduction and sections on the maximum allowable dose, protection against x-rays under the 250-kv range, protection against radioisotopes. There are appendixes dealing with radiation protection in industry and the research laboratory, the transport of radioactive materials and their disposal, protection against electricity and against television apparatus, and, finally, the norms of dosimetry for gamma rays, electrons, and neutrons.

In Memoriam

FREDERIC W. REUTER

1890–1956

RADIOLOGY reports with regret the death, on Nov. 7, of Frederic W. Reuter, of Towanda, Penna., known to many members of the Radiological Society of North America through his connection with the Patterson Screen Company and later with the DuPont de Nemours Corporation.

Frederic Reuter was born on Jan. 27, 1890, in Philadelphia and attended the schools of that city, receiving a Bachelor of Science degree in mechanical engineering from the University of Pennsylvania in 1911. In 1916, in partnership with Carl V. S. Patterson, he formed the Patterson Screen Co., which began the manufacture of a new x-ray fluoroscopic screen that Mr. Patterson had perfected two years earlier. The concern grew steadily and in July 1943 was sold to the E. I. DuPont de Nemours Corporation, with Mr. Reuter serving as assistant division manager in charge of sales until his retirement in July 1949. He was active in community and civic affairs and in 1928 was a delegate to the Republican National Convention which nominated Herbert Hoover for the Presidency.

He is survived by his widow, the former Florence Groff of Philadelphia, two sons, and a daughter.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY, *Secretary*, Theodore R. Miller, M.D., 139 E. 36 St., New York 16, N. Y.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

ASSOCIATION OF UNIVERSITY RADIOLOGISTS. *Secretary-Treasurer*, David M. Gould, M.D., University of Arkansas Medical Center, Little Rock, Ark.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, T. Leucutia, M.D., 10 Peterboro, Detroit 1, Mich.

SOCIETY OF NUCLEAR MEDICINE. *Secretary*, Robert W. Lackey, M.D., 452 Metropolitan Bldg., Denver 2, Colo.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 1313 N. Second St., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, E. A. Mendelsohn, M.D., Holt-Krock Clinic, Fort Smith. Meets quarterly.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Austin R. Wilson, M.D., 540 N. Central Ave., Glendale 3.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Lewis J. Peha, M.D., 405 N. Bedford Dr., Beverly Hills. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Steward, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, Robert B. Engle, M.D., 318B W. California St., Pasadena.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irma Smith, M.D., 450 Sutter St., San Francisco 8. Meets quarterly, at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Thomas N. Foster, M.D., 630 E. Santa Clara St., San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, James T. English, M.D., 2000 Van Ness Ave., San Francisco 9. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Lorenz R. Wurtzebach, M.D., 601 E. Nineteenth Ave., Denver 5. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, Ralph J. Littwin, M.D., Bristol Hospital, Bristol. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary-Treasurer*, Melvin O. Goodman, M.D., 1930 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. Robert DeArmas, M.D., 135 Broadway, Daytona Beach. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, André S. Capi, M.D., 300 N. 20th Ave., Hollywood, Fla. Meets monthly, third Wednesday, 8:00 P.M., at Mercy Hospital.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Marvin Harlan Johnston, M.D., Five Points Medical Center, Jacksonville 4. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Bert H. Malone, M.D., 1406 Reynolds St., Brunswick. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg., Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary-Treasurer*, Richard D. Moore, M.D., St. Francis Hospital, Honolulu 17. Meets third Monday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, R. Arthur S. J. Petersen, M.D., 11406 Parnell Ave., Chicago 28. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Robert E. Beck, M.D., 600 Mary St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer* G. S. Ripley, Jr., M.D., W. Iron Ave., Salina. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, David Shapiro, M.D., Jewish Hospital, 217 E. Chestnut St., Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, W. S. Neal, M.D., 602 Pere Marquette Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter A. Russell, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

UPPER PENINSULA RADIOLOGICAL SOCIETY. *Secretary*, Arthur Gonty, M.D., Menominee. Meets quarterly.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. J. Baggenstoss, M.D., 1953 Medical Arts Bldg., Minneapolis 2. Meets three times a year, in Fall, Winter, and Spring.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Packer, M.D., 621 High St., Jackson. Meets monthly, on third Tuesday, at 6:30 P.M., at the Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary-Treasurer*, D. R. Germann, M.D., University of Kansas Medical Center, Kansas City 3, Kans. Meets last Friday of each month.

GREATER ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Sam J. Merenda, M.D., 45 Berry Road Park, Glendale, Mo. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, John Stewart, M.D., Billings Clinic, Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thomas J. Crowe, M.D., 53 Center St., Northampton, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Raymond A. Dillon, M.D., 24 Wedgemere Ave., Winchester, Mass. Meets monthly on third Friday, October through May, at the Hotel Commander, Cambridge, Mass.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnson, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, George G. Green, M.D., 601 Grand Ave., Asbury Park. Meets at Atlantic City at time of State Medical Society and midwinter in Eliazbeth.

New York

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Harold N. Schwinger, M.D., 62 Eighth Ave. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Charles Bernstein, M.D., 685 Delaware Ave, Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ernest I. Melton, M.D., 2187 Ocean Ave., Brooklyn. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Jerome Zwanger, M.D., 126 Hicksville Road, Massapequa. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, John A. Evans, M.D., 525 E. 68th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving Van Woert, Jr., M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, T. Paul Guest, M.D., 277 Alexander St., Rochester. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arnold Myron Wald, M.D., 406 Boston Post Road, Port Chester. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, William H. Sprunt, M.D., North Carolina Memorial Hospital, Chapel Hill, N. C. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur S. Tucker, M.D., 2065 Adelbert Road, Cleveland 6. Meets at 7:00 P.M., fourth Monday, October, November, January, February, March, and April, at Tudor Arms Hotel.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Morris M. Garrett, M.D., 630 Scott Str., Covington, Ky. Meets first Monday, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. D. Robertson, M.D., Miami Valley Hospital, Dayton 9. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sol Wilner, M.D., Medical Arts Bldg., Tulsa.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, N. L. Bline, M.D., 806 S.W. Broadway, Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Robert Hanf, M.D., 807 South Auburn, Kennewick, Wash. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter P. Bitner, M.D., 234 State St., Harrisburg. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Roderick L. Tondreau, M.D., 3400 Spruce St., Philadelphia 4. Meets first Thursday of each

month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

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ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

CROSBY, R. M. N., AND BAUER, ROBERT E. Subdural Collections of Fluid in Infants and Children. II. Study with Radioactive Sodium Phosphate (P-32). 121

BOLDREY, EDWIN, ET AL. The Role of Atlantoid Compression in the Etiology of Internal Carotid Thrombosis 121

SCHULTZ, E. C., AND HUSTON, WILLIAM A. Arteriovenous Aneurysm of the Posterior Fossa in an Infant. Report of a Case 121

SLADE, HARRY W., AND GLAZER, NORMAN M. Paraphysial Cyst of the Third Ventricle 122

HORWITZ, NORMAN H., AND DUNSMORE, REMBRANDT H. Some Factors Influencing the Nonvisualization of the Internal Carotid Artery by Angiography 122

HUNTER, CURWOOD R. Indications and Technique of Cerebral Angiography 122

PETROVČIĆ, F. The Presence of Foam in the Cerebrospinal Fluid in Encephalography 122

POPPEL, MAXWELL H., ET AL. Abnormal Swallowing in Central-Nervous-System and Neuromuscular Disease 123

WINSTEN, JOSEPH, ET AL. Sialography 123

The Chest

CHAPMAN, JOHN S. Tuberculosis in Infants and Children. A Review 123

THORN, P. A., ET AL. Peptic Ulcer, Partial Gastrectomy, and Pulmonary Tuberculosis 124

STEIN, SAMUEL C., AND SOKOLOFF, MARTIN J. Calcification of Regional Lymph Nodes Following BCG Vaccination 124

COMSTOCK, GEORGE W. Tuberculosis Studies in Muscogee County, Georgia. V. Tuberculosis Mortality During Seven Years After a Community-Wide Survey 124

CICERO, RAÚL, ET AL. Selective Angiopneumography and a Correlative Study of Bronchography and the Histopathologic Findings in Tuberculous Fibrothorax 124

BRETT, G. Z., ET AL. Static Mass Radiography in a London Borough 125

PAULSON, DONALD L. The Importance of the Pulmonary Nodule 125

FORD, WILLIAM B., ET AL. "Coin" Lesions of the Lung 125

SCHMIDT, ERNST A. The Differential X-Ray Diagnosis of Pulmonary Carcinoma 125

AMUNDSEN, PER, AND SÖRENSEN, EDVIN. Angiocardiography in Intrathoracic Tumours with Particular Reference to the Question of Operability 126

CELIS, ALEJANDRO, ET AL. The Importance of the Thoracic Duct in the Spread of Malignant Disease 126

PALAMIDESSI, CARLO. Middle Lobe Atelectasis of Neuroreflex Origin (?) 126

MARINO, CARLO. Brief Clinical Consideration of the Pathogenesis of "Functional" Atelectasis 126

SANTAGADA, A., AND PIAZZI, M. Contribution to the Radiologic Study of Intrathoracic Goiter with Axial Transverse Stratigraphy 127

PINHEIRO, ARMANDO, AND OUTEIRO, FERNANDO. A Few Cases of Glandular-Bronchial Fistula. 127

MOLOSHOK, RALPH E., AND MOSELEY, JOHN E. Familial Dysautonomia: Pulmonary Manifestations 127

GROVES, LAURENCE K., AND EFFLER, DONALD B. Broncholithiasis. Twenty-Seven Cases 128

The Cardiovascular System

SOLOFF, LOUIS A., ET AL. Angiocardiographic Observations of Intracardiac Flow in the Normal and in Mitral Stenosis 128

DALITH, F. Systolic Expansion or Aorto-Diastolic Displacement. A Roentgenkymographic Study of Left Atrial Movements in Mitral Cardiopathy 128

BROWN, JAMES W., ET AL. Ebstein's Disease 129

EYLER, W. R., ET AL. Malignant Argentaffinoma Associated with Cardiovascular Abnormalities 129

MERTEN, CHARLES W., ET AL. The Antemortem Diagnosis of Syphilitic Aneurysm of the Aortic Sinuses. Nine Cases 129

SMART, JOSEPH, AND PATTINSON, J. N. Congenital Absence of Left Pulmonary Artery 130

SHAPIRO, B. J., AND SIMOR, E. S. Thrombosis of Internal Carotid Artery 130

WESSLER, STANFORD, ET AL. The Temporary Thrombotic State. Application of This Concept to the Therapy of Recurrent Thromboembolism with Bacteriologic and Roentgenologic Considerations in the Differential Diagnosis of Pulmonary Infarction and Pneumonia 130

SALOTTI, AD., AND LUNGHETTI, D. Functional Roentgenologic Findings in Vascular Disorders. 131

ROBY, H. R., AND MCKAY, J. W. Fatality Following Abdominal Arteriography 131

The Digestive System

SETÄLÄ, KAI, AND SIURALA, MAX. Roentgenologic Signs of Chronic Gastritis 131

SPENSLEY, ROBERT D., ET AL. Unusual Causes of Free Intraperitoneal Air in Acute Conditions of the Abdomen 131

BARCLAY, T. H. CRAWFORD, AND KENT, H. P. Primary Carcinoma of the Duodenum 131

BURGERMAN, ARTHUR, ET AL. Primary Malignant Neoplasms of the Duodenum, Excluding the

Papilla of Vater. A Clinicopathologic Study of 31 Cases ... 132
GANEM, EMIL J., ET AL. Anterior Displacement of the Descending Duodenum as an Aid in the Diagnosis of Retroperitoneal Tumor. A Roentgenographic Sign of Possible Significance in Some Cases of Enlargement of the Right Adrenal Gland ... 132
SCHWACHMAN, HARRY, ET AL. Meconium Ileus. A Clinical Study of Twenty Surviving Patients ... 132
CHÉRIGIÉ, E. Radiology of the Inflamed Small Intestine. Functional and Organic Signs of Inflammatory Disease ... 133
FINDLEY, JOHN W., JR., AND THOMPSON, WILLIAM H. Multiple Lipomas of the Ileum ... 133
MARSHAK, RICHARD H., AND ELIASOPH, JOAN. Pneumatosis Coli ... 133
HEIFETZ, CARL J. Acute Pneumocholecystitis ... 134
JUNIPER, KERRISON, JR., AND WOOLF, WILLIAM E. Biliary Tract Studies. I. X-Ray Diffraction Analysis of Gallstones; Correlation with Occurrence of Microspheroliths in Bile ... 134
MANDEL, WILLIAM, ET AL. Evaluation of Oral Cholecystography in Liver Disease ... 134
GAEBEL, E. The Negative or Faint (Weak Contrast) Cholecystogram and the Diagnosis of Cholecystitis ... 134
ADAMS, JOHN D., AND NOEL, R. D. Operative Cholangiograms. A Critical Review of Their Value ... 135
WISE, ROBERT E., AND O'BRIEN, RICHARD G. Interpretation of the Intravenous Cholangiogram ... 135
BERK, J. EDWARD, ET AL. The Use of Iodipamide Methylglucamine (Cholografin High Potency) for Intravenous Cholangiography ... 136
BORIS, A., AND LÖRINC, P. Advantages and Disadvantages of the Morphine Effect Combined with Biligrafin Examination ... 136
MITCHELL, DAVID J. Basic Combined Cholecystangiography ... 136

The Spleen

WANG, C. C., AND ROBBINS, LAURENCE L. Roentgenologic Diagnosis of Ruptured Spleen ... 137

Hernia

BROWN, CHARLES H., ET AL. Compound Diaphragmatic Hernia. Five Cases ... 137

The Musculoskeletal System

GREEN, MORRIS, ET AL. Acute Hematogenous Osteomyelitis ... 138
TOONE, ELAM C., JR., AND KELLY, JOHN. Joint and Bone Disease Due to Mycotic Infection ... 138
FOGEL, MARIE, AND FEJÉR, ROSE. Hyperostosis Generalisata ... 138
TURNER, ELIZABETH K. The Ellis-Creveld Syndrome: Case ... 139
DEWITTE, F. Osteomyelitis and Sarcoma ... 139
SUTOW, WATARU W., AND PRYDE, ARTHUR W. Incidence of Spina Bifida Occulta in Relation to Age ... 139
RATLIFF, A. H. C. Tuberculosis at the Site of Spondylolisthesis ... 139
HOLSTI, LARS R. Osteochondritis Ischiopubica ... 140
FRANCHI, B. Radiological Signs of Congenital Subluxation of the Hip, with Description of a New Sign ... 140
POWELL, H. D. W. Interdigital Sinuses in Barber's Hand ... 140

Obstetrics and Gynecology

RATELLE, GERMAINE, AND LÉGER, JEAN-LOUIS. Roentgen Findings in Genital Tuberculosis in Women ... 140
GALE, GODFREY L., AND GIFFIN, R. H. Pneumoperitoneum in the Diagnosis of Pelvic Disease ... 141

The Genitourinary System

DI SIENO, ANTONIO, AND GUARESCHI, BRUNO. The Radiologic Picture of Medullary Sponge Kidney: Review of the Literature and Presentation of Two Cases ... 141
BIANCHI, EMO. Roentgenologic Findings in Uretero-Appendicular Fistula ... 141
SILVIS, RICHARD S., ET AL. Aneurysm of the Renal Artery ... 142
HALE, BRIAN C. Hypaque in Intravenous Pyelography. An Analysis of 50 Controlled Examinations Comparing Hypaque with 50 Per Cent Diodone ... 142
GREEN, B., AND SOWERBUTTS, J. G. A Comparative Study of the Value of Sodium Acetrizoate (Diaginol) 50 per cent and Sodium Diatrizoate (Hypaque) 45 per cent in Intravenous Urography ... 142
CAVE, P., ET AL. Report on 1028 Cases of Intravenous Urography with Sodium Acetrizoate (Diaginol) as Contrast Medium ... 142
WALD, ARNOLD M. Nephrography During Routine Excretory Urography ... 142

The Adrenals

ABRAMOV, A., ET AL. Generalized Xanthomatosis with Calcified Adrenals ... 142

Miscellaneous

ALDRIDGE, N. H. Combined-Intravenous Cholecystography and Pyelography ... 143
GLASSMAN, IRVING, ET AL. Air Embolism During Presacral Pneumography: Case ... 143

RADIOTHERAPY

HENDRICK, JAMES W. Treatment of Cancer of the Nasal Cavity and Paranasal Sinuses ... 143
RENFER, HANSRUDOLPH. The Treatment of Skin Tumors of the Inner Canthus with Regard to the Function of the Lacrimal Ducts ... 143

LEROUX-ROBERT, JEAN. Indications for Radical Surgery, Partial Surgery, Radiotherapy and Combined Surgery and Radiotherapy for Cancer of the Larynx and Hypopharynx 144
WATSON, T. A. Supervoltage Roentgen Therapy in Cancer of the Lung 144
SCHÄRER, K. Radiation Therapy of Carcinoma of of the Esophagus 144
GAMBACCINI, P.: Radiation Combined with Surgery in the Treatment of Rectal Neoplasms in Various Stages 145
JAVERT, CARL T., AND DOUGLAS, R. GORDON. Treatment of Endometrial Adenocarcinoma. A Study of 381 Cases at the New York Hospital. A Preliminary Report 145
VERHAGEN, AUGUST. Dose Decrease in Bladder and Rectum in Gynecologic Radium Treatments 146
SEPP, PETER. The Phosphamidase in Cells of Vaginal Smears in Cervix Carcinoma Before and After Radiotherapy 146
LOCKWOOD, IRA H., AND CHAPMAN, SAMUEL B. Therapy of Carcinoma of the Urinary Bladder. 146
MOSTOFI, F. K.: A Study of 2678 Patients with Initial Carcinoma of the Bladder: I. Survival Rates. II. Survival Rates in Relation to Therapy 146
FLOCKS, R. H. The Treatment of Urethral Tumors 146
NADOLNY, G. Teleroentgentherapy in the Treatment of Neoplastic Metastases 147
HALL, CHARLES A., AND OLSON, KENNETH B. Therapy of Malignant Lymphomas. I. A Study of 116 Cases. II. A Review 147
GRETENER, ADOLPH J. Lymphosarcoma: Clinical Picture, Therapy, and Prognosis. Experiences of the Department of Radiation Therapy of the University of Zürich from 1936 to 1951 147
FLATMAN, G. E., AND ELLIS, R. E. A Report on the Use of Convergent Beam X-Ray Therapy 148
COLLINS, VINCENT P., AND LOEFFLER, R. KENNETH. The Therapeutic Use of Single Doses of Total Body Radiation 148
DU SAULT, LUCILLE A. Time-Dose Relationships 148
BLOEDORN, FERNANDO G. Application of the Paterson-Parker System in Interstitial Radium Therapy 149
KLIGERMAN, MORTON M., ET AL. A Graphical Method for the Localization of Radium Sources for Dosage Calculation 149
HOLT, J. GARRETT. A Nomographic Wheel for Three Dimensional Localization of Radium Sources and Calculation of Dose Rate 150
FISHMAN, ROBERT, AND CITRIN, LESTER I. A New Radium Implant Technique to Reduce Operating Room Exposure and Increase Accuracy of Placement 150
STICKLEY, E. E. Neutron Capture Therapy: Slow Neutron Depth Distribution Measurements in Tissue 150

RADIOISOTOPES

HUGHES, H. A., AND MILLER, R. M. Plasma Activity Levels in Radioiodine Tests of Thyroid Function 150
CATZ, BORIS, AND STARR, PAUL. Cancer of the Thyroid, with Metastases to the Lungs Condition Shown by Scintigram in Absence of Definite X-Ray Findings 150
LINDELL, BO, AND WALSTAM, RUNE. A New Telegamma Apparatus 151
PADOVAN, IVO, AND FRANK, PAVAO. Technic of Irradiation with Radioactive Cobalt 151
KEETTEL, WILLIAM C., AND ELKINS, H. B. Experience with Radioactive Colloidal Gold in the Treatment of Ovarian Carcinoma 151
SCHOOLMAN, HAROLD M., AND SCHWARTZ, STEVEN O. Aplastic Anemia Secondary to Intravenous Therapy with Radiogold. Report of a Case 152
LUTTERBECK, EUGENE F., AND HUMMON, IRVIN F., JR. Clinical Experiences with the Strontium 90 Applicator 152
SMOLIK, EDMUND A., ET AL. Blood Volume Changes in Cases of Cerebral Trauma as Determined by Radioactive Isotopes 152

RADIATION EFFECTS

CAMERMAN, J. Roentgenographic Examinations and Radiation Hazard 153
FRITZ-NIGGLI, HEDI. Professional Radiation Injuries in Medical Practice 153
HAIGH, MARY V., AND PATERSON, EDITH. Effects of a Single Session of Whole Body Irradiation in the Rhesus Monkey 154
HICKS, SAMUEL P., ET AL. Time-Intensity Factors in Radiation Response. 1. The Acute Effects of Megavolt Electrons (Cathode Rays) and High- and Low-Energy X-Rays with Special Reference to the Brain 154
CERTA, H., AND HEITE, H.-J. On the Spreading Effect of X-Rays as Measured by Intradermal Pressure 155

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Subdural Collections of Fluid in Infants and Children. II. Study with Radioactive Sodium Phosphate (P-32). R. M. N. Crosby and Robert E. Bauer. J. Neurosurg. **13**: 140–144, March 1956. (R. M. N. C., 11 E. Chase St., Baltimore 2, Md.)

A non-surgical method to detect the presence of encapsulation in infants and children (with an open fontanelle) with subdural collections of fluid has been sought. It has been noted previously (Bauer *et al.*: Cancer **7**: 852, 1954. Abst. in Radiology **65**: 151, 1955) that radioactive phosphorus concentrates in pleural and peritoneal effusions. In view of this fact the authors investigated the possibility of similar concentration in subdural collections of fluid. Radioactive sodium phosphate in quantities of 1 to 2 ml., containing 100 to 200 microcuries of radioactive phosphorus, was injected intravenously and samples of subdural fluid and blood were obtained after a three-hour period. Subdural activity was then expressed by the formula $\frac{\text{CPM/ml. subdural fluid}}{\text{CPM/ml. plasma}} \times 100$.

Subdural collections resulting from malnutrition or certain metabolic disorders have a much lower activity than those caused by trauma or inflammatory processes. Collections on the basis of nutritional disorder ranged in subdural P^{32} activity from 6 to 70, while those based on trauma or inflammatory disease ranged from 68 to 218. In both situations higher activity was seen in encapsulated collections than in cases in which no organized capsule was found at operation. In collections resulting from nutritional disorders, activity of 15 or above is considered indicative of encapsulation. In traumatic or inflammatory collections, activity below 120 suggests lack of encapsulation, activity of 130 or above usually indicates the presence of a capsule, though 1 patient with an activity of 136 was shown to have an unencapsulated collection.

The authors believe that, if the cause of the subdural collection is known, it is possible by their method to predict the presence or absence of encapsulation. If, on the other hand, the presence or absence of encapsulation is known but the cause is not, information concerning the etiology may be obtained. In cases with borderline results, trephination with inspection should be performed for absolute safety.

One figure; 1 table. RICHARD G. LESTER, M.D.
University of Minnesota Hospitals

The Role of Atlantoid Compression in the Etiology of Internal Carotid Thrombosis. Edwin Boldrey, Lyman Maass, and Earl Miller. J. Neurosurg. **13**: 127–139, March 1956. (University of California Medical Center, San Francisco, Calif.)

The authors present a clinical review of 24 cases of angiographically demonstrated occlusion of the internal carotid artery, assumed in all to be the result of thrombosis. They are concerned particularly with the potential role of compression by the lateral process of the atlas in the etiology of some of these cases. Most of the cases occurred in the fourth, fifth, and sixth decades.

Many etiologic factors have been implicated in internal carotid occlusion. Arteriosclerosis, thromboangiitis obliterans, diabetes, polycythemia, trauma, and vasospasm have all been suggested. In 5 of the patients in this group the occlusion was at the level of the transverse process of the atlas as seen by carotid angiography. The internal carotid artery is in close relation to the lateral process of this vertebra, especially when the head is turned in the lateral position. In addition, in older patients, there are almost constantly adhesions binding the carotid sheath to the carotid artery and to adjacent tissues in this area. There may then be actual adhesion of the carotid artery to the lateral process of the atlas. If prolonged arterial compression results from the lack of mobility of these two structures on one another, the intima of the artery may be injured. In such a case thrombosis may result. As further evidence for this hypothesis the authors point to the fact that apparent occlusion without the actual presence of thrombosis may be seen when carotid angiography is performed with the head turned laterally.

A case is presented in which transitory hemiparesis was noted by a patient with the head turned in the lateral position. After an interval a renewal of signs and symptoms, not entirely transitory, was noted under similar circumstances. At operation the carotid artery was found to be densely adherent to the lateral process of the atlas. The adhesions were interrupted, and no further symptoms were noted in the ensuing six and one-half years.

Four roentgenograms; 2 drawings; 1 table.
RICHARD G. LESTER, M.D.
University of Minnesota Hospitals

Arteriovenous Aneurysm of the Posterior Fossa in an Infant. Report of a Case. E. C. Schultz and William A. Huston. J. Neurosurg. **13**: 211–214, March 1956. (E. C. S., 525 Physicians and Surgeons Building, Memphis 3, Tenn.)

Vascular malformations of the posterior fossa in infancy are extremely rare. This paper reports the case of a two-month-old child who had a spontaneous subarachnoid hemorrhage from an arteriovenous aneurysm of the posterior fossa. Ventriculography demonstrated symmetrical enlargement of the third and lateral ventricles with no filling of the fourth ventricle or aqueduct. The patency of these latter structures was demonstrated by pneumoencephalography. One month later, rapid enlargement of the head was observed, and pneumoencephalography revealed an obstruction of the fourth ventricle, which contained an apparent mass outlined by air. Suboccipital craniectomy was undertaken and, when the dura was opened, a mass presented in the mid-line, yielding arterial blood on operation. The operation was terminated without any definitive procedure and approximately one week later a vertebral angiogram was obtained. This showed a large mid-line aneurysmal sac in the posterior fossa, fed by the left vertebral artery and draining into the straight sinus. A second suboccipital craniectomy was performed, and two divisions of the left vertebral artery were clipped, with temporary arrest of the pulsations in the aneurysm. The entire left cerebellar hemisphere was cystic and degenerative, being largely replaced by a huge angiomatous mass. This mass, together with the aneurysmal sac, was dissected free and divided from its vascular

attachments. The infant tolerated the procedure well and was later discharged from the hospital.

Microscopically, the mass was predominantly composed of small capillaries interspersed between portions of edematous cerebellar tissue. The aneurysm was made up of thickened muscular tissue lined by endothelium. Since no elastic tissue was demonstrated in the cyst wall, it was probably derived from venous tissue.

This is believed to be the first case report of an arteriovenous aneurysm of the posterior fossa in an infant successfully diagnosed and removed.

Two roentgenograms; 2 photographs.

JOHN W. WILSON, M.D.
Johnstown, Penna.

Paraphysial Cyst of the Third Ventricle. Harry W. Slade and Norman M. Glazer. Am. J. Surg. **91:** 431–435, March 1956. (H. W. S., 3395 Scranton Road, Cleveland 9, Ohio)

The authors report in fuller detail a case included in an article on paraphysial cysts of the third ventricle appearing in Radiology **67:** 351, 1956. The patient was a fourteen-year-old boy.

Nine roentgenograms; 2 photomicrographs; 2 photographs. GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Some Factors Influencing the Nonvisualization of the Internal Carotid Artery by Angiography. Norman H. Horwitz and Rembrandt H. Dunsmore. J. Neurosurg. **13:** 155–164, March 1956. (Hartford Hospital, Hartford, Conn.)

Failure to demonstrate the internal carotid artery in the neck associated with adequate visualization of the common and external carotid arteries has been considered diagnostic of internal carotid obliterative disease. The authors present 4 cases which appear to indicate that similar angiographic findings can be produced by certain hemodynamic factors, as yet unexplained.

In all 4 patients, an increase in intracranial pressure occurred somewhat precipitately; all were moribund at the time of angiography; in none was it possible to demonstrate contrast medium in the intracranial portions of the internal carotid artery; all suffered from some disease of the vascular system of the brain.

In the first case autopsy was not done, and the exact nature of the pathologic process is therefore unestablished. A ruptured aneurysm or angiomatous malformation was considered to have been responsible for a subarachnoid hemorrhage. Clinically the second patient was believed to have had a massive infarction secondary to thrombosis of the right middle cerebral artery. Though the original angiogram failed to show filling of the intracranial portions of the internal carotid, postoperative studies suggested that the artery had thrombosed near its bifurcation. Operation itself revealed no clot. The possibility of recanalization of an earlier thrombus is suggested, but the interval between the pre- and postoperative studies is too brief to support this view.

In the third case, autopsy showed a ruptured aneurysm at the origin of the posterior communicating artery on the right. The carotid arteries were of normal caliber and patent. Since no anatomic obliteration was found, it must be concluded that factors affecting the cerebral blood flow were responsible here. In the fourth patient an extensive subarachnoid hemorrhage was found at autopsy with rupture in the subdural space, predominantly on the left. The brain was edematous. The bleeding site could not be identified. The intracranial portion of the left carotid artery was patent.

Brain stem compression from intracranial pressure is known to have existed in 3 and possibly all 4 of the cases. This has been said to lead to a depressor reaction with a resultant drop in cerebral blood flow. It is also possible that a sympathetic response producing dilatation of the external carotid system might well result in a shunt of the bulk of the opaque medium from the internal carotid so that insufficient concentration was present for visualization.

It is reasoned that a reflex phenomenon by way of sympathetic and parasympathetic ganglia in the diencephalon mediates a vascular response, and compression of this structure may occasion the neural reflex altering intracranial circulation. The actual neural pathways, however, have not been identified, and the etiology remains largely conjectural.

Eight roentgenograms. JOHN W. WILSON, M.D.
Johnstown, Penna.

Indications and Technique of Cerebral Angiography. Curwood R. Hunter. Ohio State M. J. **52:** 264–266, March 1956. (Good Samaritan Hospital, Cincinnati, Ohio)

The technic and indications for cerebral angiography are briefly reviewed, and some general observations are made.

Since the irritating effects of Diodrast (35 per cent) as a contrast medium have been demonstrated, every effort should be made to find a satisfactory substitute; recent evidence suggests that Urokon in 30 per cent concentration is superior, but final evaluation requires further clinical trial. Thorotrast, although abandoned as a contrast medium because of its radioactivity and sarcogenic properties, merits fresh consideration; as the least irritating of all agents used to date, it could with advantage be reserved for the aged and for patients with vascular occlusive disorders.

Attention is called to the possibility of contamination of saline by powder, gauze, and cotton lint, since these agents as well as air and clot may occasionally act as emboli and account in part for the distressing sequelae of cerebral angiography (transient hemiplegia, sensory phenomena, convulsions, exaggeration of neurological disturbances, or death).

Greater effort might be directed toward the development of mechanical seriographic x-ray devices, with standardization of angiography, the purpose being to determine the various phases of vascular filling. The author believes this would be most helpful in facilitating accurate preoperative tumor diagnosis and recognition of the smaller vascular anomalies, which are at present not recorded because of the incomplete character of the studies.

Four roentgenograms.

The Presence of Foam in the Cerebrospinal Fluid in Encephalography. F. Petrovčić. Radiol. clin. **25:** 120–124, March 1956. (In German) (Opća bolnica "Dr. Stojanovic," Vinogradska 28, Zagreb, Yugoslavia)

The radiologic appearance of foam on the surface of

fluid in a hydropneumothorax has already been described (Cocchi: Radiol. clin. **17:** 35, 1948. Abst. in Radiology **52:** 137, 1949). A similar picture has been found in 20 out of 110 encephalographic studies in children. With the horizontal beam, the level of cerebrospinal fluid had an irregularly toothed appearance. The perpendicular beam disclosed multiple oval shadows, resembling cells in a honeycomb or soap bubbles. The author believes that the general unrest in children during the execution of the examination accounts for the generation of foam. The relative infrequency of the condition in adults is due to their more quiet behavior. In children it could be produced by intentionally shaking those who previously presented no foam.

Albumin in the cerebrospinal fluid and a sufficiently large surface are the necessary conditions for the formation of foam. The hydrocephalic ventricular system, especially the lateral ventricles, fulfills such conditions.

Three roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Abnormal Swallowing in Central-Nervous-System and Neuromuscular Disease. Maxwell H. Poppel, Harold G. Jacobson, Jerome H. Shapiro, Howard Adler, and Joseph Stein. Am. J. Digest. Dis. **1:** 116–125, March 1956. (Department of Radiology, Bellevue Hospital Center, New York 16, N. Y.)

The authors discuss the physiology of the swallowing mechanism and review the literature on the roentgen study of this function. In a group of 41 patients with neurologic and neuromuscular disorders were 8 with paralysis agitans, 7 with multiple sclerosis, 7 with muscular dystrophy, 6 with amyotrophic lateral sclerosis, 5 with myasthenia gravis, 3 with hemiplegia and 1 each with dystonia muscularis deformans, posterolateral sclerosis, myotonia dystrophica, epileptiform degeneration, and numbness of undetermined origin.

The authors studied the swallowing function by a multiple-film technic with the Fairchild camera, though they state that this could also be done with fluoroscopy and routine film studies. The normal roentgenologic findings and the abnormal features observed are described, but no attempt is made to correlate specific findings with individual diseases.

Eight film series; 1 table.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Sialography. Joseph Winsten, David M. Gould, and Grant E. Ward. Surg., Gynec. & Obst. **102:** 315–321, March 1956. (Johns Hopkins University and Hospital, Baltimore, Md.)

The authors report their findings in a series of 53 sialograms. Sialography was found to be of definite diagnostic value in cases of suspected parotid disease. It can demonstrate an inflammatory process as well as a neoplasm. In certain cases of carcinoma, it may even suggest the malignant nature of the tumor. Sialography may also be of aid in differentiating lesions of nearby structures from those involving the gland itself.

The technic is described briefly. Iodized oil (Iodochlorol) or an absorbable medium (Dionosil Oily) may be used. If necessary, the stoma of the duct can be probed with a graduated series of lacrimal dilators until No. 3 or No. 4 is reached. Approximately 1.75 c.c. of contrast substance is injected slowly and steadily into the duct. Pausing from time to time spares the patient all but minimal discomfort.

The following roentgenograms are taken: a true antero-posterior view, a true lateral view, a basal view of the skull, and a tangential view, varied according to the area involved. The authors use a system based upon three planes of reference rather than on standard anatomic points for exact localization of the lesions.

Sialographic lesions are of three types: (1) Space-taking lesions extrinsic to the parotid gland include tumors, lymph node metastases, and hemorrhage. In these cases the entire gland or a large portion appears to to be displaced *en masse*. (2) Intrinsic space-taking lesions exerting pressure on the duct system include tumors, cysts, and abscesses. The ducts appear to sweep around and embrace the mass. At times they appear attenuated and stretched taut. (3) Abnormalities within the duct system itself are usually due to inflammatory processes. Sialectasis, which is apparently a result of inflammation, produces a distinct roentgenologic pattern.

Seventeen roentgenograms; 1 photograph; 2 tables.

FRANK WHITE, M. D.
University of Pennsylvania Hospital

THE CHEST

Tuberculosis in Infants and Children. A Review. John S. Chapman. Am. Rev. Tuberc. **73:** 422–433, March 1956. (5323 Harry Hines Blvd., Dallas 19, Texas)

This study is based on 101 children having what was regarded as significant tuberculous disease in the chest or in extrapulmonary sites. In most of these patients, the illness took the form of fever, malaise, and weight loss. The diagnosis was confirmed by biopsy, cultures, and differential clinical studies. More than half of the patients were less than three years of age on admission. Pulmonary disease was found in 72 cases; the right lung was involved in 34 patients, and the left in 13, with involvement of both lungs in the remaining 25. In 12 children, there was necrosis with cavity formation, and in 8, pleural effusion. There were only 7 patients with bone and joint involvement, chiefly because the patients were on a pediatric and not an orthopedic service. Lymphadenitis of superficial nodes was present in 20 instances, and meningitis in 21. There were 8 deaths, 6 of which occurred before isoniazid was used.

Mediastinal lymphadenopathy was a common finding and was believed to account for the difference in frequency of involvement of the right and left lungs, since bronchial obstruction of the right middle and/or upper lobes led to the pulmonary findings in many instances. Often the lobes re-expanded during the course of treatment and no pulmonary parenchymal lesion could be defined.

Multiple sites of involvement suggested multiple sites of invasion in some instances. The author feels that division of tuberculosis into primary and secondary types is often meaningless because of the repeated occurrence of necrosis at sites of invasion, the development of the superficial implantation type of bronchitis, and the occurrence of pleural effusion in these infants with what was presumed to be their first infection.

The author also discusses treatment, pointing out the value of isoniazid-PAS in the various manifestations of tuberculosis observed in children. In addition, drainage of fluctuant superficial nodes was carried out, along

with radiation therapy, when the nodes were multiple or when palpable masses persisted after drainage.

Thirteen roentgenograms; 7 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Peptic Ulcer, Partial Gastrectomy, and Pulmonary Tuberculosis. P. A. Thorn, V. S. Brookes, and J. A. H. Waterhouse. Brit. M. J. **1:** 603–608, March 17, 1956. (P. A. T., Wolverhampton Hospital, Wolverhampton, England)

With the clinical suspicion that partial gastrectomy predisposes to pulmonary tuberculosis in the years that follow operation, the authors undertook a review of 955 patients who had had a partial gastrectomy for peptic ulcer. Seven hundred seventy-two were men and 183 were women. The patients were studied as to the effect of various factors on the annual attack rate. Eight with gastric ulcer, 5 with duodenal ulcer and 1 with both gastric and duodenal ulcer were found to have pulmonary tuberculosis after an earlier normal film; the annual attack rate for gastric ulcer alone was three times that for duodenal ulcer alone. For patients with gastric ulcer, those with high ulcers had the highest annual attack rate. In addition, the patients with more extensive gastric resections had a greater tendency toward tuberculosis.

The patient's preoperative weight had considerable influence on subsequent pulmonary tuberculosis. Patients with initial normal x-ray films of the chest who were less than 85 per cent of their standard weight before operation were about fourteen times more likely to have pulmonary tuberculosis after operation. In men with gastric ulcer the annual attack rate of this same underweight group was five times that of those whose weight was normal.

After a rather intensive statistical analysis the authors conclude that, following operation, the annual attack rate of pulmonary tuberculosis in men with normal x-ray films before operation is high, due to the high attack rate in those already more than 15 per cent under their standard weight before operation. If the chest film and weight are normal before partial gastrectomy, there is not an abnormal risk of developing pulmonary tuberculosis later. The development of pulmonary tuberculosis after partial gastrectomy is due primarily to the presence of severe or long-standing peptic ulceration and only secondarily to the effects of the operation.

Seven tables.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Calcification of Regional Lymph Nodes Following BCG Vaccination. Samuel C. Stein and Martin J. Sokoloff. Am. Rev. Tuberc. **73:** 239–245, February 1956. (S. C. S., Henry Phipps Institute of University of Pennsylvania, Philadelphia 47, Penna.)

Freshly prepared BCG vaccine was injected into the skin over the deltoid muscle in 287 white and 1,618 Negro infants within twenty-four to forty-eight hours after birth. Follow-up roentgenograms showed calcification in axillary nodes in 7 (20.6 per cent) of 34 white children and in 42 (8.8 per cent) of 471 Negro children. This change was observed as early as two months after vaccination. The time of appearance was not studied specifically, but it was within one year in most instances. The number of white children studied was not of statistical significance, but it should be noted that the incidence of calcification was higher than in the Negro group. Calcification was most common in patients with enlarged non-suppurative nodes. Sex distribution was equal in white children, but among the Negroes, males showed calcification in 13.6 per cent in contrast to 8.0 per cent in females.

Node swelling in adults following BCG vaccination is uncommon, and the authors suggest that some structural difference in the nodes may account for this. Calcification is favored by incomplete absorption of necrotic material from tuberculous lymph nodes, which evidently occurs more often in infants than in adults.

Three roentgenograms; 3 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Tuberculosis Studies in Muscogee County, Georgia. V. Tuberculosis Mortality During Seven Years After a Community-Wide Survey. George W. Comstock. Am. Rev. Tuberc. **73:** 157–164, February 1956. (United States Public Health Service, Columbus, Ga.)

Tuberculosis deaths were analyzed over a seven-year period following a community chest roentgenographic survey. The mortality was high: 340 deaths per 100,000 for whites and 1,490 for Negroes with evidence of tuberculosis in their survey films. In contrast, the mortality in whites with normal survey films was 3 per 100,000, while in Negroes it was 45. This leads to the conclusion that roentgenographic survey of a white population followed by adequate isolation of infectious cases is an effective method of controlling pulmonary tuberculosis. In Negro populations, however, it is apparent that the case-finding programs should be repeated more frequently. This study did not indicate that persons with tuberculosis tended to avoid participation in the survey.

Five tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Selective Angiopneumography and a Correlative Study of Bronchography and the Histopathologic Findings in Tuberculous Fibrothorax. Raúl Cicero, Hermilo del Castillo, Martha Fernández and Mario Moulún. Am. Rev. Tuberc. **73:** 61–71, January 1956.

Thirty-six patients were studied by means of selective angiopneumography, which consisted in the injection of 15 to 20 ml. of Diodrast into the catheterized pulmonary artery on the diseased side. All of the patients underwent subsequent bronchography, and in 19 histopathologic study on pneumonectomy specimens was performed. Hemithoracic opacity fused with the cardiac shadow was evident in all instances, along with pronounced retraction of the mediastinal structures toward the affected side, elevation of the diaphragm, and costal retraction. All patients had tubercle bacilli in the sputum and showed absence of oxygen consumption on the affected side.

The most frequent angiographic alteration was diminution and distortion of the arterial trunks. Complete absence of the vascular tree was also observed, as well as a small residual arterial stump without branches. On bronchography by direct bronchial catheterization, alterations varying from moderate bronchiectasis to marked changes with practically no segmental arborizations were found. Histopathologically there were diffuse and eccentric proliferation of the intima and hypertrophy of the muscular layer of the arteries; complete obstruction was found in smaller vessels. These changes were not specific for tuberculosis. The bronchi

showed dilatation with flabby walls and decrease or disappearance of muscular fibers. Bronchiectasis was commonly saccular in fibrotic disease, and in extensive destructive disease the bronchial tree was largely destroyed, with cavities draining into main bronchi.

Global angiopneumography (study of the pulmonary circulation following injection of the contrast medium at a site more or less distant, anatomically, from the pulmonary artery) failed to demonstrate vessels in several patients in whom arteries were apparent on selective angiopneumography. This indicates that the vessels are patent but that there is little, if any, blood flowing through them unless pulmonary artery pressure is increased.

There was no correlation possible between bronchographic studies and selective angiopneumography.

Twelve roentgenograms; 4 photomicrographs.

JOHN H. JUHL, M.D.
University of Wisconsin

Static Mass Radiography in a London Borough. G. Z. Brett, B. Benjamin, J. Wallace Craig, and V. Freeman. Brit. M. J. **1:** 719–722, March 31, 1956. (G. Z. B., Islington Mass X-ray Unit, North-West Metropolitan Regional Hospital Board, Islington, London, England)

The results of a static mass miniature radiographic unit carried out over a three-year period are reported. The unit was set up in 1952 in Islington, a metropolitan borough of London, because of the higher than average tuberculosis mortality in that area. A total of 87,261 adults were examined, of whom 86 per cent were examined for the first time; more than half of the examinees were residents of Islington, representing about 21 per cent of the adult population of the borough.

The overall incidence of pulmonary tuberculosis was 7.7 per 1,000; the frequency was highest among those referred by doctors and individual volunteers (as opposed to office and industrial groups). The disease, particularly the chronic infectious type in persons over forty-five years of age, was more prevalent in men of the lowest social class and in the retired. Sixty-two per cent of cases in males and 37 per cent of cases in females were found to be sputum-positive. A total of 115 cases of cancer of the lung were discovered, with the prevalence again apparently higher in the less privileged.

It is concluded that mobile mass miniature radiography offers an important protective service for the organized groups of the working population, while static mass miniature radiography, owing to its wider range of coverage and persistence of tenure, can contribute to a substantial reduction of the disease in areas in which pulmonary tuberculosis is a serious problem. For the same reason, static mass radiography is capable of playing an important role in the detection of cancer of the lung.

Twelve tables.

The Importance of the Pulmonary Nodule. Donald L. Paulson. Minnesota Med. **39:** 127–136, March 1956. (Southwestern Medical School, Dallas, Texas)

The author bases his discussion of the pulmonary nodule on a series of 180 patients seen between 1945 and 1955, and on a review of the literature. He points out that among 897 instances of these lesions collected from the literature, 323 (36 per cent) were found to be malignant. In his own series, 80 per cent of the patients were operated upon and the diagnosis was pathologically confirmed. In 13 per cent of the cases, the diagnosis was established on a clinical and roentgenographic basis, and in the remaining 7 per cent the lesions were not amenable to classification.

Proper evaluation of the pulmonary nodule requires the use of special roentgen technics, including planigraphy, a survey of the patient's general condition, and, unless contraindicated, prompt surgical removal of the lesion with histologic examination.

The size and density of the nodule are of relative roentgenologic significance. It is believed that lesions of medium and small size and light density should be regarded as malignant, that lesions of medium and small size and medium density require careful study, and that lesions of heavy density are likely to be benign. Reference is made to a new sign of malignancy reported by Rigler, namely, notching or umbilication of a border of the shadow (J.A.M.A. **157:** 907, 1955. Abst. in Radiology **66:** 129, 1956), though absence of this sign does not exclude the possibility of a malignant lesion. Lamination, calcification, or a surrounding halo are suggestive of granuloma or a benign lesion, although calcification alone is not regarded as sufficient to overrule surgery and histologic examination for elimination of the possibility of cancer.

Twelve roentgenograms; 7 tables.

"Coin" Lesions of the Lung. William B. Ford, Edward M. Kent, John F. Neville, Jr., and Don L. Fisher. Am. Rev. Tuberc. **73:** 134–138, January 1956. (W. B. F., 717 Liberty Ave., Pittsburgh 22, Penna.)

A total of 124 "coin" (1 to 4 cm.) lesions excised at the University of Pittsburgh between January 1951 and January 1955 were reviewed. Sixty-five (52.4 per cent) of them were found to be malignant. Five bronchial adenomata were included in the malignant group. Ninety per cent of patients with cancerous lesions were over forty years of age, while only 40 per cent of patients in the benign group were more than forty. A review of 729 such coin lesions reported in the literature disclosed an overall incidence of 37.3 per cent of malignant tumors.

Most of these lesions do not produce symptoms. Laboratory methods are helpful in the diagnosis of cancer in less than 25 per cent of the patients. Tomography is recommended for definition of the tumor. When the diagnosis cannot be made on the foregoing bases, exploratory thoracotomy with excision of the mass is indicated.

Three tables.

JOHN H. JUHL, M.D.
University of Wisconsin

The Differential X-Ray Diagnosis of Pulmonary Carcinoma. Ernst A. Schmidt. Indian J. Radiol. Souvenir Number: 105–126, 1956. (944 Waianuenue Ave., Hilo, Hawaii)

The author feels that a definite relation exists in many cases between the pathologic and radiologic tumor appearance, and that the tumor type and histologic structure as well as the clinical course can often be predicted from the radiologic picture. Review of the literature suggests that squamous-cell carcinomas, which form about 45 to 60 per cent of all bronchogenic carcinomas, prefer the major bronchi and are only occasionally found peripherally. They show an overwhelming preference for the male sex, are generally slow-growing, well circumscribed, and frequently are surrounded by in-

flammatory reaction. Bronchostenosis, atelectasis, infection and necrotic changes with cavitation are frequent. If located in a center of a lobe, these tumors may attain an enormous size before invasion of the adjacent tissues or metastasis.

Anaplastic, small-cell, and similar carcinomas, comprising about 30 per cent of all bronchogenic cancers, are relatively more frequent below the age of forty years, still predominating in the male. They are centrally located, due to their usual origin in a main bronchus; only rarely do they occur beyond the lobar bronchi. They have irregular outlines blending with the mediastinal shadow and later presenting the "sunburst" appearance typical of lymphatic spread. They show rapid growth, with involvement of the cervical lymph nodes and the vagus and recurrent laryngeal nerves. Necrotic changes are minimal.

Adenocarcinomas represent about 15 per cent of bronchogenic carcinomas. Though they predominate in men, they are nevertheless the most common pulmonary carcinoma in women. In general, these tumors are more often encountered peripherally than other tumor types. Their progress is more rapid than that of the epidermoid type but slower than of the anaplastic type. Generally, well delineated masses are formed within the lung parenchyma, usually separable from the mediastinum and inclined to nodular pulmonary dissemination and pleural involvement.

As regards primary "alveolar-cell" carcinoma, the opinions of pathologists are still divided. Most favor the assumption that these tumors arise in the bronchioles rather than in the alveoli. They comprise about 2 to 5 per cent of all pulmonary carcinomas. They may be of the single diffuse or multiple nodular type. The latter is likely to be erroneously diagnosed as pulmonary metastasis, fungous disease, tuberculosis, or pneumonitis.

The author lists and discusses extensively the many inflammatory lesions, benign and other malignant pulmonary tumors, and vascular abnormalities which must be considered in the differential diagnosis of pulmonary carcinoma.

Twenty-seven roentgenograms; 2 drawings.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Angiocardiography in Intrathoracic Tumours with Particular Reference to the Question of Operability. Per Amundsen and Edvin Sörensen. Acta radiol. **45:** 185–198, March 1956. (Roentgen Department, Ullevål Sykehus, Oslo, Norway)

Angiocardiographic examination in the presence of an intrathoracic tumor is of little help in deciding whether the lesion is or is not a neoplasm. It does, however, give the surgeon the anatomic extent of the tumor and may tell whether or not it is operable.

Centrally situated tumors may cause narrowing of the main branches of the pulmonary arteries or changes in their levels. The authors believe that 1.8 cm. should be regarded as the smallest normal diameter for the left main pulmonary artery. Differences in level between the right and left main branches exceeding 2.5 cm. or less than 1.0 cm. indicate displacement of one of the branches.

Physiologic narrowing of the vena cava occurs during auricular systole and may be a source of error unless serial exposures are made.

Study of the circulation through the small vessels and capillaries of the lungs is important. Failure of a segment, a lobe or a lung to fill suggests vascular occlusion and often indicates the level of the occlusion.

If there is a block in the peripheral circulation of a lung while the diameter of the main pulmonary artery remains normal, occlusion of the artery is ruled out. If, in such cases, emphysema and other parenchymal diseases are not found, and the circulation is still radiographically restricted, there probably is a block in the great lung veins. This justifies the diagnosis of inoperability.

Using these criteria in 37 cases, the roentgen interpretations of the authors and the surgical findings have shown close correlation.

There is a certain inherent risk in carrying out the procedure, and it is contraindicated when other examinations suggest inoperability. It should be done in all cases where operation is intended, in order to spare the occasional patient with an irremovable tumor an unnecessary thoracotomy.

Eleven roentgenograms; 2 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

The Importance of the Thoracic Duct in the Spread of Malignant Disease. Alejandro Celis, José Kuthy, and Ermilo del Castillo. Acta radiol. **45:** 169–177, March 1956. (Tuberculosis Service and Department of Experimental Surgery, General Hospital, Mexico, D. F.)

Obstruction of the thoracic duct by ligation brings about the formation of anomalous lymphatic collaterals, which sometimes communicate with the venous system. This was demonstrated by the authors, who succeeded in catheterizing the ducts on 44 human cadavers and numerous dogs. Roentgenograms obtained after injections of an opaque medium showed many variations, and clearly revealed the importance of the thoracic duct as a route by which cancer cells may enter the venous system and thus invade the lungs.

Epithelial neoplasms tend to invade the lymphatic system, while those of connective tissue are usually spread by the hematogenous route. The lympho-hematogenous route, *via* the thoracic duct and innominate vein, is believed to account for a high number of pulmonary metastases, the incidence of which varies somewhat with the site of the primary tumor. They follow a primary growth below the diaphragm in a high percentage of cases, but may come from direct extension into the duct of bronchial and esophageal cancers.

If carcinoma obstructs the duct, the development of collaterals often brings about an anomalous distribution of the metastases.

Eight roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Middle Lobe Atelectasis of Neuroreflex Origin (?). Carlo Palamidessi. Riv. ital. di radiol. clin. **6:** 35–40, January–February–March 1956. (In Italian) (Dispensario di Pescia-Consorzio Provinciale Antitubercolare di Pistoia, Pescia, Italy)

Brief Clinical Consideration of the Pathogenesis of "Functional" Atelectasis. Carlo Marino. Riv. ital. di radiol. clin. **6:** 41–45, January–February–March 1956. (In Italian)

The first of the papers listed above concerns a 40-year-old woman with a complete atelectasis of the right middle lobe but otherwise apparently well. Bronchoscopy, performed at the height of the atelectatic process,

and all other examinations were completely negative The patient recovered spontaneously (over night) and remained asymptomatic, with clear lung fields. In the absence of any other explanation, the author suggests the possibility of a "neuroreflex" origin of the atelectasis.

Three roentgenograms are reproduced.

The second paper opens with a review of the causes of atelectasis, which were classified in older textbooks under two headings, obstruction and compression. To these must be added a third group, so-called active retraction. It has been shown experimentally that four to six hours are needed for the resorption of air from the parenchyma after complete obstruction of the corresponding bronchus. However, clinical and roentgen examinations have demonstrated that, in certain cases, the atelectasis occurs suddenly, a phenomenon which cannot be explained except on the basis of active retraction of pulmonary tissue.

Histologic studies have been made in an attempt to create an anatomical basis for this theory. Lung tissue contains smooth musculature and an elastic system, and both are said to be under the influence of parenchymal nerve endings, subject to functional reflexes, but these assertions have given rise to much controversy. It may be recalled that pathologic bronchial stenosis is not always necessary to explain a right middle lobe opacification: pulmonary ventilation and bronchial clearing are jeopardized by the small volume of the middle lobe, by its supradiaphragmatic and paracardiac location, and by the multiple angulation of its bronchus, the curvature of which may be altered by respiratory motion. Even so, the existence of a neuroreflex (functional) atelectasis cannot be entirely ruled out.

[Sudden atelectases have been observed mainly during anesthesia. The speed of resorption of air from the pulmonary parenchyma depends upon its composition: carbon dioxide disappears most rapidly, but even oxygen should not take longer than ten minutes. Nitrogen has the slowest absorption rate. One may speculate about the relationship between the gas content of pulmonary air during certain phases of anesthesia and the incidence of sudden atelectasis—E. R. N. G.]

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Contribution to the Radiologic Study of Intrathoracic Goiter with Axial Transverse Stratigraphy. A. Santagada and M. Piazzi. Ann. di radiol. diag. **29:** 186–213, 1956. (In Italian) (Istituti di Radiologia e del Radio dell'Università di Bologna, Italy)

The ectopic goiter may be of the (1) migrant type, connected to the main gland by a bridge of thyroid tissue, or of the (2) *aberrant* type, either completely separated from the cervical thyroid or having a common blood supply with it. The intrathoracic (mediastinal) goiter is more often anterior than posterior to the *intervenous fascia*, which stretches between the two venous brachiocephalic trunks, dividing the superior mediastinum in two compartments, a ventral one, corresponding to the thymus, and a dorsal one, the peritracheo-esophageal space. Most authors regard the mediastinal goiter as an evolutionary process, which starts out as a tongue of thyroid tissue, and extends downward into the anterior mediastinum; it may stop there (cervicomediastinal goiter) or it may circumvent the trachea and esophagus (laterovisceral location) and reach the posterior mediastinum.

The *differential diagnosis* is simplified by the demonstration of continuity of the mediastinal mass with the cervical thyroid. For this purpose, axial transverse body-section roentgenography (stratigraphy) is the best method short of surgery. The extensions of the mass can be seen, displacement of adjacent organs can be recognized, and impingement upon the trachea becomes particularly easy to evaluate. The method has proved, for instance, that either anterior or posterior intrathoracic goiters may fill the entire superior mediastinum. Associated artificial (diagnostic) pneumomediastinum may be employed in unusual circumstances, while stratigraphy alone is recommended as a routine procedure in the presence of a mediastinal mass.

Twenty roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

A Few Cases of Glandular-Bronchial Fistula. Armando Pinheiro and Fernando Outeiro. Gaz. méd. Portuguesa. **9:** 175–183, March-April 1956. (Sanatório D. Manuel II, Villa Nova de Gaia, Portugal)

Five case histories are presented to illustrate the importance of body-section roentgenography in the diagnostic evaluation of perforation of a caseous (tuberculous) lymph node into a bronchus. Primary acid-fast infection was the supposed cause in the first 2 cases, specific reactivation in the other 3. A cavity could be demonstrated in all but the fourth patient. Bronchoscopic confirmation was obtained in each instance.

In the first patient, a boy of ten, tomography revealed a cavity within an involved lymph node, which compressed the adjacent bronchi, and caused a dilatation at the main bifurcation. The second patient, a seven-year-old girl, showed involvement of the azygos lymph node, with granuloma and perforation into the main bronchus, which subsequently healed with noticeable bronchial stenosis. In the third case, in a man of thirty-four, tomography demonstrated cavitation within a "right superior interlobar adenopathy." In the fourth case, in a male of twenty-seven, an azygos node had perforated into the trachea, a very rare occurrence. In the fifth patient, a twenty-seven-year-old woman, bronchography was also done, demonstrating a fistulous tract leading from the right main bronchus into a cavity left by the evacuated lymph node.

Twelve roentgenograms, each with explanatory drawing. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Familial Dysautonomia: Pulmonary Manifestations. Ralph E. Moloshok and John E. Moseley. Pediatrics **17:** 327–333, March 1956. (R. E. M., 73 E. 90th St., New York 28, N. Y.)

Riley, who has published a number of reports on the syndrome of familial dysautonomia, called attention to the frequency of pulmonary infections in his patients (J.A.M.A. **149:** 1532, 1952). [The more constant clinical features of the syndrome include deficient lacrimation, which may lead to corneal ulceration; almost exclusive occurrence in Jewish infants; skin blotching ranging from facial and cervical flushing to marked redness interspersed with areas of cyanosis, when the children are stimulated or offered food; increased perspiration; excessive drooling; and a variety of nervous system aberrations ranging from motor instability, motor incoordination, and hyporeflexia to indifference to pain.]

The present authors found significant pulmonary

difficulties in 13 of 20 cases of this syndrome. The repeated episodes of pneumonia or bronchitis begin in infancy and are ushered in by cough, dyspnea, and fever. In 6 of the cases in this series a presumptive diagnosis of fibrocystic disease of the pancreas was made. In several patients there were diffuse moist râles and wheezes in the chest associated with feeding or emotional upsets.

Roentgenographic findings include bilateral, more or less diffuse, chronic interstitial infiltrations with occasional acinar involvement. Initially fine, the infiltrates coarsen and remain for extended periods, associated with emphysema due to bronchial obstruction. The classical signs of emphysema, including widening of the intercostal spaces, increased radiolucence of the lung between infiltrates, and depression of the diaphragm, are seen. The emphysema may be lobar or even lobular.

Atelectasis commonly results when the bronchus is completey occluded by increased secretions and is most often seen in the right upper lobe or one of its segments, with displacement of the trachea and convexity of the adjacent fissure toward the area of involvement. This atelectasis may involve other segments of the lung and remains unchanged for protracted periods, even months.

Superimposed on the persistent pattern of diffuse interstitial infiltration and emphysema, small patchy areas of lobular pneumonia or lobular atelectasis may come and go. The most common finding is a varying combination of interstitial infiltrate, right upper lobe atelectasis, and emphysema with or without bullae.

The appearance of the infiltrates on central nervous system stimulation and their poor response to chemotherapeutic and antibiotic agents substantiate the claim that the pulmonary findings stem from bronchial hypersecretion and resultant obstruction. The pathogenesis also accounts for the similarity of the x-ray findings to those seen in fibrocystic disease of the pancreas.

Three cases are reported in detail.

Seven roentgenograms. SAUL SCHEFF, M.D.
Boston, Mass.

Broncholithiasis. A Review of Twenty-Seven Cases. Laurence K. Groves and Donald B. Effler. Am. Rev. Tuberc. **73:** 19–30, January 1956. (L. K. G., 2020 E. 93rd St., Cleveland 6, Ohio)

Calcification in lymph nodes adjacent to the tracheobronchial tree is a result of chronic inflammatory disease, such as tuberculosis, histoplasmosis, and other fungous infections, or any other chronic pulmonary suppuration. These masses of calcium may erode into an adjacent bronchus and produce symptoms, of which the most common in the authors' series of 27 cases were hemoptysis, cough, and bronchial obstruction. Roentgenographic findings in order of frequency were prominent calcifications, obstructive pneumonitis plus atelectasis, and bronchiectasis (on bronchography). Two patients had hilar enlargement, and broncholithiasis was suggested as the diagnosis in 2 others. Treatment consisted of resection in 21 cases and endoscopic removal in 3; the remaining 3 were not treated. Sixteen lobectomies, 3 pneumonectomies, and 1 wedge resection were performed. In 7 of the lobectomies, the middle lobe was included, which suggests the importance of lymph node compression in the middle-lobe syndrome.

The incidence of symptomatic and significant broncholithiasis is low in comparison with the high incidence of mediastinal and hilar node calcification. It is well to be aware of the possibility of this condition and to consider it in patients with hemoptysis or signs of bronchial obstruction, particularly when large calcified hilar nodes are present. The authors believe that the surgical approach with resection offers the best results in treatment.

Eleven roentgenograms; 6 tables; 1 photograph.
JOHN H. JUHL, M.D.
University of Wisconsin

THE CARDIOVASCULAR SYSTEM

Angiocardiographic Observations of Intracardiac Flow in the Normal and in Mitral Stenosis. Louis A. Soloff, Jacob Zatuchni, Herbert M. Stauffer, and Eugene W. Kelly. Circulation **13:** 334–350, March 1956. (L. A. S., 255 S. 17th St., Philadelphia 3, Penna.)

An elaborate time study was made by the authors on the flow of a radiopaque medium through the heart and lesser circulation in normal subjects and in patients with mitral stenosis, with and without valvulotomy. The time of appearance and degree of opacification in various chambers were reduced to graphic form for comparison (as in the method described by Lind, Spencer, and Wegelius in Circulation **11:** 609, 1955. Abst. in Radiology **66:** 298, 1956).

A distinctive pattern was found in mitral stenosis, but this was not specific, since it was seen in other left-sided heart lesions and even in a case of cor pulmonale. The pattern in an individual case could be seen to change somewhat after valvulotomy or after improvement following treatment, but there was no general characteristic pattern for the post-valvulotomy cases. The findings did not make it possible to predict the degree of stenosis of the mitral valve nor the presence or amount of regurgitation.

[In spite of what they did not find, the authors have performed a definite service in recording these basic data, from which forward steps will undoubtedly be made. Anyone interested in mitral stenosis should read the original paper.—Z. F. E.]

Twelve roentgenograms; 2 figures; 3 tables.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Systolic Expansion or Aorto-Diastolic Displacement. A Roentgenkymographic Study of Left Atrial Movements in Mitral Cardiopathy. F. Dalith. Acta radiol. **45:** 217–230, March 1956. (Roentgen Department, Government Hospital, Tel-Hashomer, Israel)

In mitral stenosis pulsatile expansion of the left atrium has been considered a diagnostic fluoroscopic sign for valvular incompetence, having been attributed to a regurgitant jet during systole. The sign, however, has been observed in numerous cases where no such jet could be found at surgery. As a result, the author has felt the need to re-evaluate its significance.

By means of kymographic examinations on 131 patients with mitral stenosis who were operated upon, the following observations were made:

1. No difference in left auricular movements (as shown by kymograms of the barium-filled esophagus) between pure mitral stenosis and mitral stenosis with regurgitation.

2. No kymographic evidence of systolic expansion

of the left atrium in any case of mitral incompetence.

3. Kymographic waves of identical shape in the esophagus and aorta in all mitral disease cases.

The conclusion is reached that the movement previously described as systolic left atrial expansion is really a transmitted pulsation from the aorta and that, for the present, we are left without a reliable roentgen sign of mitral regurgitation.

Fourteen kymograms; 1 table; 3 diagrams.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Ebstein's Disease. James W. Brown, Donald Heath, and William Whitaker. Am. J. Med. **20:** 322–333, March 1956. (The Regional Cardiovascular Centre, City General Hospital, Sheffield, England)

Four cases (2 proved by autopsy) of Ebstein's disease are here described. The condition consists of a downward displacement of the tricuspid valve into the right ventricle, to divide it into two parts: a proximal portion forming part of the atrial cavity and a distal ventricular portion. The posterior and medial cusps arise directly from the wall of the ventricle and the interventricular septum, respectively, and only part of the anterior cusp arises from the annulus fibrosus. A patent foramen ovale often accompanies the anomaly.

Clinical findings usually include exertional dyspnea, tachycardia, cyanosis beginning after infancy, and cardiac enlargement, particularly involving the right auricle. Electrocardiograms reveal right atrial enlargement and right bundle branch block in most cases.

Chest roentgenograms characteristically show moderate to marked heart enlargement, with a very prominent right border due to the large right atrium. Pulmonary vascularity is diminished. Angiocardiography reveals a very large right auricle, from which contrast medium empties rather slowly. An interauricular septal defect may be shown.

Cardiac catheterization is regarded as prohibitively hazardous in this condition. In the 3 cases in which it was performed, the catheter tip coiled within the large right auricle.

Conditions to be differentiated include Fallot's tetralogy, tricuspid atresia, and rheumatic pericarditis with effusion.

Ebstein's disease is compatible with many years of active adult life, and surgery has no place in treatment at present.

Ten roentgenograms; 3 photographs; 4 electrocardiograms; 5 tables. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Malignant Argentaffinoma Associated with Cardiovascular Abnormalities. W. R. Eyler, H. Tesluck, and E. H. Drake. New England J. Med. **254:** 555–559, March 22, 1956. (W. R. E., Henry Ford Hospital, Detroit 2, Mich.)

A case of malignant argentaffin tumor with an increase in facial telangiectasis and cyanosis, as well as development of the murmurs of tricuspid insufficiency and pulmonic stenosis, during observation is presented. The association of argentaffinoma and valvular lesions of the heart was first recognized by Biörck and his associates (Am. Heart J. **44:** 143, 1952). The cardiac component of the syndrome has ordinarily consisted of stenosis of the pulmonary valve, but the tricuspid valve has frequently been involved. The attendant vasomotor disturbances, manifested by facial cyanosis and telangiectasis, have in some cases made clinical diagnosis of the syndrome possible.

The authors' patient was a forty-five-year-old male with a fifteen-year history of intermittent attacks of cramping abdominal pain after meals. Abdominal roentgen examination showed no abnormalities, but symptoms persisted, and three years later laparotomy revealed a carcinoid tumor of the distal ileum, with spread to the regional nodes, peritoneum, and liver. Thirty months after this, the patient was again seen. In the interval, telangiectasis of the face, noted on the original examination, had increased, and a gross systolic murmur was now heard over the tricuspid valve. Subsequent roentgen examinations showed progressive enlargement of the right atrium and ventricle. Angiocardiography confirmed the diagnosis of pulmonary stenosis of the valvular type. Cardiac catheterization excluded a shunt and indicated a valvular lesion. On the assumption of possible tumor metastasis to the heart, x-ray therapy was instituted, but death occurred. At autopsy the heart changes were found to consist of marked, endocardial thickening, involving chiefly the inner aspect and the base of the pulmonic leaflets and the entire right atrium.

There seems to be little doubt that the mediator of the effect of the carcinoid tumor on the heart is serotonin or its metabolites. This process is similar to fetal endocardial fibroelastosis in that both lesions show the primary changes restricted to the endocardium, with an increase in thickness, and in both the processes can involve valves, with the production of stenosis. Fibroelastosis most commonly affects the left side of the heart, whereas no left-sided lesions have been reported in association with malignant argentaffinoma. This lesion also differs from fibroelastosis in that there is no evidence of incorporation of elastic tissue in the plaques. In fibroelastosis the entire architecture of the valve is involved with fibrous thickening and hyalinization whereas, in the case reported here, the valve was distorted by endocardial change only.

Three roentgenograms; 1 photograph; 2 photomicrographs. THEODORE E. KEATS, M.D.
University of Missouri

The Antemortem Diagnosis of Syphilitic Aneurysm of the Aortic Sinuses. Report of Nine Cases. Charles W. Merten, Nathaniel Finby, and Israel Steinberg. Am. J. Med. **20:** 345–360, March 1956. (Departments of Radiology and Medicine, New York Hospital-Cornell Medical Center, New York, N. Y.)

Nine cases of syphilitic aneurysm of the aortic sinuses diagnosed antemortem by angiocardiography are reported. In addition, 19 cases, previously recorded in the literature, are reviewed.

Dilatations of the sinuses above the aortic valve cusps may be saccular and localized, or they may be in continuity with a fusiform aneurysm of the ascending aorta. They usually cause aortic insufficiency and heart failure. Precordial pain may occur, due to stenosis of the coronary ostia in the right and left sinuses.

Diagnosis should be suspected when aortic regurgitation is present, or when calcification is demonstrable roentgenographically within the ascending aorta. Diagnosis can be confirmed by angiocardiography, which characteristically shows increased width of the aortic sinuses and bulging of the aneurysm against the neighboring cardiovascular structures.

Rupture of the aneurysm may occur into the heart, into the lesser circulation, or outside the heart.

Uncomplicated sinus aneurysms do not uniformly have an ominous prognosis. Four of the authors' 9 patients were alive after five years of observation.

Seventeen roentgenograms; 9 drawings; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Congenital Absence of Left Pulmonary Artery. Joseph Smart and J. N. Pattinson. Brit. M. J. **1:** 491–493, March 3, 1956. (London Chest Hospital, London, England)

Absence of a pulmonary artery may occur on either side, but is slightly more common on the left than on the right, being often associated with congenital heart disease, particularly of the cyanotic type. When there is no evidence of heart disease, absence of the right pulmonary artery appears to be more frequent.

After a brief review of the literature, the authors report a case of absence of the left pulmonary artery in a man of thirty. A chest film had shown the left lung to be smaller than the right, with some mediastinal shift toward the left but no evidence of atelectasis. The right pulmonary artery shadow was larger than normal. Bronchograms revealed a normal bronchial tree bilaterally and a right-sided aortic arch. They showed, also, the large right pulmonary artery but no shadow of a left pulmonary artery at the left hilus. On the angiocardiogram a normal main pulmonary trunk was demonstrated ascending from the right ventricle. This vessel did not bifurcate but continued in an even curve to the right to become continuous with the right pulmonary artery. There was no evidence of a left pulmonary artery, the only pulmonary vessel supplying the left lung being a tiny one 2 mm. in diameter passing down to the lower lobe. The virtually complete absence of a pulmonary supply to the left lung suggested that the latter served no useful function. Bronchospirometry showed the ventilation of each lung to be normal and equal, but the oxygen uptake on the right side was 390 ml. a minute while on the left side no oxygen was absorbed.

Absence of one of the pulmonary arteries in itself produces few or no symptoms. The diagnosis can be suspected from the plain radiographs. The affected lung is usually smaller than the normal one, with small intrapulmonary vascular shadows. There may be poor development of the hemithorax and diminished movement of the diaphragm on that side. The contralateral lung is often enlarged, with increased radiolucency, and the mediastinum is frequently displaced toward the affected side. The presence of a large pulmonary artery, which may even be aneurysmal, on the contralateral side and the absence of the shadow of the normal pulmonary artery at the hilus on the affected side are important signs. Bronchograms usually show a normal bronchial tree. Angiocardiography will confirm the diagnosis.

Three roentgenograms; 1 graph.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Thrombosis of Internal Carotid Artery. B. J. Shapiro and E. S. Simor. J. Canad. A. Radiologists **7:** 5–8, March 1956. (B. J. S., 550 University Ave., Toronto 2, Ontario, Canada)

The authors report 12 cases of thrombosis of the internal carotid artery, 9 of which were recognized on angiograms done to rule out tumor or aneurysm. Three were discovered at autopsy.

The diagnosis of internal carotid artery thrombosis requires demonstration of the actual site of obstruction, not mere lack of filling. In this series, anteroposterior and lateral angiograms were taken with the patient so positioned that the cervical portion of the common carotid and the region of its bifurcation could be clearly seen.

There is excellent anastomosis between the branches of the external carotid artery and the internal carotid, furnishing at least four collateral routes of circulation in addition to the anterior communicating artery. The degree of patency of these anastomotic channels accounts for the difference in symptoms in internal carotid artery thrombosis. Some patients are symptomless, while others suffer complete hemiplegia.

Of the 9 patients in the present series in which the thrombosis was demonstrated by angiography, 8 were between the ages of thirty-seven and fifty-three, suggesting that the disease affects relatively young people. The condition is apparently due to atherosclerosis, which frequently occurs at the bifurcation of the common carotid artery and in the region of the carotid syphon. Angiography on the normal side is believed to be contraindicated since death has been known to occur in cases in which this procedure was used.

Six roentgenograms; 1 drawing.

PAUL MASSIK, M.D.
Quincy, Mass.

The Temporary Thrombotic State. Application of This Concept to the Therapy of Recurrent Thromboembolism, with Bacteriologic and Roentgenologic Considerations in the Differential Diagnosis of Pulmonary Infarction and Pneumonia. Stanford Wessler, Sidney Cohen, and Felix G. Fleischner. New England J. Med. **254:** 413–419, March 1, 1956. (Beth Israel Hospital, Boston, Mass.)

Since the time of Virchow the triad held chiefly responsible for thrombus formation has been intimal damage, stasis of blood, and its increased coagulability. The authors emphasize the last of these mechanisms and postulate a syndrome in which as yet unknown factors produce a state of hypercoagulability of the blood, without any clinically detectable signs of peripheral venous stasis or of intimal damage. This they designate "the temporary thrombotic state." In its presence, the laying down of clot can be initiated and then potentiated by a degree of vascular stasis that would not of itself lead to thrombus formation.

Vital to effective clinical management in accordance with this concept is the ability to diagnose thromboembolism. A particularly common and difficult problem is differentiation of pulmonary infarction secondary to pulmonary artery obstruction and pneumonia. Sputum examination and blood cultures in the bacterial pneumonias are often helpful. Many of the non-bacterial pneumonias may be differentiated by serologic studies, including the cold-agglutinin test. Histoplasmosis and coccidioidomycosis may be recognized by direct smear and culture of the sputum and by skin and complement-fixation tests.

Roentgenologically, pulmonary embolism may show classic infarction: a truncated cone of density with the base directed to a pleural surface (diaphragmatic,

interlobar, mediastinal or costal), usually occurring in the lower lung fields, particularly the costophrenic angles and only rarely in the upper lung fields. Infarcts are most often segmental and tend to disappear within days to weeks, without leaving a trace on the roentgenogram. Other evidences of embolism include signs of respiratory inhibition, basal atelectasis, oligemia in a portion of the lung, pleural effusion, pulmonary edema, and acute cor pulmonale. Chronic cor pulmonale secondary to recurrent pulmonary emboli is quite characteristic in appearance. The heart shadow on the postero-anterior film resembles that of mitral stenosis but without dilatation of the left atrium. There is a concavity of the left heart border at the site of the left atrium, and the pulmonary artery is dilated. The right ventricular enlargement is best appreciated on lateral and oblique views.

The authors present a case history illustrating the usefulness of their concept of a "temporary thrombotic state" and the difficulties of differentiating pulmonary infarction and pneumonia.

Four roentgenograms.

SAUL SCHEFF, M.D.
Boston, Mass.

Functional Roentgenologic Findings in Vascular Disorders. Ad. Salotti and D. Lunghetti. Riv. ital. di radiol. clin. **6:** 3–34, January-February-March 1956. (In Italian) (Via Cherubini, 11, Firenze, Italy)

The authors believe that peripheral angiography, even in routine cases, should include seriograms of the entire limb as well as single-slot kymograms. The changes in vessel caliber and in blood distribution, as a function of time and location, can provide the elements needed to evaluate the peripheral vascular dynamics in a given instance. Additional physiopathologic information can be gained by observing the reaction of terminal artery areas and anastomotic systems after administration of vasodilators (acetylcholine, Priscol, etc.). Angiography may furnish details of considerable significance in making therapeutic decisions as, for example, the efficiency of collateral circulation in the presence of obstruction.

Sixty-eight roentgenograms; 1 diagram.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Fatality Following Abdominal Arteriography. H. R. Roby and J. W. McKay. J. Canad. A. Radiologists **7:** 1–4, March 1956. (H. R. R., Montreal General Hospital, Montreal 25, Quebec, Canada)

This is a single case report, with brief discussion, of a fatality following translumbar arteriography with 50 c.c. of 70 per cent Urokon under general anesthesia. The patient was a seventy-three-year-old Chinese male suffering from arteriosclerosis obliterans of the lower extremities. Following arteriography inferior mesenteric thrombosis occurred, with gangrene of a large segment of the large bowel (sigmoid).

The authors postulate that trauma by the needle, plus acute distention of the vessel during injection, caused acute reflex vasospasm followed by thrombosis. There were, however, well advanced arteriosclerotic changes in the inferior mesenteric artery, and the patency of its lumen was already compromised, when the examination was undertaken.

One roentgenogram.

PAUL MASSIK, M.D.
Quincy, Mass.

THE DIGESTIVE SYSTEM

Roentgenologic Signs of Chronic Gastritis. Kai Setälä and Max Siurala. Acta radiol. **45:** 199–211, March 1956. (Second Medical Clinic and Department of Pathology, University of Helsinki, Helsinki, Finland)

The authors report an investigation carried out in an effort to establish roentgenographic criteria by which gastritis might be diagnosed. Four hundred and one patients were examined roentgenologically and by gastroscopy. In 203 of these biopsy of the gastric mucosa was performed. Several illustrative cases are presented.

Results indicate that no single x-ray finding is a reliable indication of atrophic gastritis. Irregular coarsening or thickening of the gastric mucosal folds with stiffening, if marked, is a dependable radiographic indication of disease of the gastric mucosa. This, however, is a rough and superficial means for diagnosing gastritis, as the relief changes evidently depend mainly upon the condition of the muscularis mucosae.

Five roentgenograms; 5 photomicrographs; 4 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Unusual Causes of Free Intraperitoneal Air in Acute Conditions of the Abdomen. Robert D. Spensley, Robert E. Nelson, and Wesley A. Childs. Am. J. Surg. **91:** 344–350, March 1956. (R. D. S., VA Hospital, Albuquerque, N. M.)

The association of free abdominal air with perforated peptic ulcer is well known. According to the authors, however, approximately 25 per cent of all cases of pneumoperitoneum in acute disease of the abdomen will be due to other conditions than perforated ulcer. Numerous separate entities which may be responsible for this phenomenon are listed. Those mentioned include perforations of the gut incidental to various inflammatory diseases, malignant lesions, trauma, and obstruction, as well as idiopathic perforations. Cases have also been reported following the use of a douche, performance of the Rubin test, and knee-chest position exercises.

Of 32 cases seen at Albuquerque Veterans Hospital, 9 were due to causes other than peptic ulceration. This series included 2 perforated carcinomas of the stomach, 2 traumatic perforations, 3 cases of inflammatory origin, 1 case of volvulus, and 1 of perforated appendix. An additional case of rupture of a sigmoid colon diverticulum is cited. All 10 cases are summarized briefly.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Primary Carcinoma of the Duodenum. T. H. Crawford Barclay and H. P. Kent. Gastroenterology **30:** 432–446, March 1956. (T. H. C. B., Allan Blair Memorial Clinic, Saskatchewan Cancer Commission, Regina, Sask., Canada)

Among 20,137 primary malignant tumors investigated in the Clinics of the Saskatchewan Cancer Commission between 1932 and 1953, there were 8 primary carcinomas of the duodenum, representing only 0.19 per cent of all gastrointestinal cancers and 33.3 per cent of all small intestinal cancers.

There is no characteristic syndrome by which primary malignant disease of the duodenum may be recognized. It is probable that in most cases the tumor is silent until complicated by hemorrhage or obstruction

of the duodenum or biliary tract. Melena occurred in 3 of the 8 patients, and 6 were markedly anemic, but at the time of referral all but 1 of the 8 had other localizing symptoms. Six were jaundiced; 5 had a palpable abdominal mass.

Radiographic deformities included annular and ulcerating defects as well as eccentric and concentric strictures. Rigidity of the duodenal wall and peristalsis were of no help in diagnosis. In only 1 instance was there widening of the duodenal loop.

Postbulbar peptic ulcer is sometimes difficult to distinguish from carcinoma but may be suggested by convergent mucosal folds and spasm of the opposite wall. Tuberculosis and regional enteritis may be differentiated by their simultaneous occurrence elsewhere. Ampullary carcinomas are indistinguishable from duodenal carcinomas except for their characteristic location. Metastatic lymph nodes compressing, invading, and obstructing the duodenum appear similar to primary carcinoma. Primary sarcomas of the duodenum are indistinguishable from carcinoma.

In an attempt to differentiate pancreatic cancer from carcinoma of the duodenum, 74 cases of carcinoma of the pancreas were reviewed. Fourteen patients in this series manifested duodenal deformities. Widening of the duodenal loop and elevation of the stomach were observed 9 times, a feature which, as pointed out above, was unusual in carcinoma of the duodenum. Mucosal changes were noted only 3 times. Three patients had obstruction of the duodenum, with the primary cause unidentified radiographically.

Prognosis in carcinoma of the duodenum is poor because of extensive spread prior to diagnosis and surgical inaccessibility of regional lymph nodes.

Eight roentgenograms; 1 table.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Primary Malignant Neoplasms of the Duodenum, Excluding the Papilla of Vater. A Clinicopathologic Study of 31 Cases. Arthur Burgerman, Archie H. Baggenstoss, and James C. Cain. Gastroenterology **30:** 421–431, March 1956. (J. C. C., Mayo Clinic, Rochester, Minn.)

In a review of 25,032 necropsies at the Mayo Clinic (1910–1953), 31 primary cancers of the duodenum were found. Twenty-seven were adenocarcinomas, 2 were leiomyosarcomas, 1 was a lymphosarcoma, and 1 was a reticulum-cell sarcoma.

The majority of the tumors (80 per cent) were in the first or second portion of the duodenum and were of the ulcerating or polypoid type. Abdominal pain and loss of weight were the outstanding clinical symptoms. Melena occurred in only 9 of 30 patients questioned, although 17 were anemic. Jaundice developed in the course of the illness in only 7 cases.

Metastasis had occurred in 20 of the 31 cases, most commonly to the regional lymph nodes and the liver. No evidence was observed indicating malignant change in a benign ulcer.

Of the 22 patients examined roentgenographically, 11 were thought to have a malignant duodenal tumor and 4 were thought to have an ulcer. In 7 the findings were indeterminate or no lesion was seen.

Four photographs; 4 photomicrographs; 2 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Anterior Displacement of the Descending Duodenum as an Aid in the Diagnosis of Retroperitoneal Tumor: A Roentgenographic Sign of Possible Significance in Some Cases of Enlargement of the Right Adrenal Gland. Emil J. Ganem, David W. Wallwork, and George V. West. New England J. Med. **254:** 552–555, March 22, 1956. (Lawrence General Hospital, Lawrence, Mass.)

The authors discuss anterior displacement of the descending duodenum as a roentgenographic sign of possible significance in some cases of enlargement of the right adrenal gland. They report a case of carcinoma of the right adrenal gland in which anterior displacement of the descending duodenum was demonstrated on a view of the upper gastrointestinal tract obtained in the right lateral recumbent position after the ingestion of barium. Neither the intravenous nor the retrograde pyelogram had shown any significant caudal displacement of the right kidney or alteration of its normal axis.

The anatomical relations between the right adrenal gland, descending duodenum, and lumbar spine are described. The second portion of the duodenum is 7 to 10 cm. long and extends along the right side of the vertebral column as far down as the upper border of the fourth lumbar vertebra. The level of apposition of the duodenum with the anterior aspect of the adrenal and kidney varies in different persons. In cases in which the duodenum has a high level of apposition with the adrenal base, one may reasonably expect to demonstrate anterior displacement of the second portion of the duodenum when the gland is enlarged.

The authors point out that the x-ray examination as described is simple and safe and may render unnecessary more complicated diagnostic tests such as lumbar aortography and retroperitoneal pneumography in an occasional patient with tumor of the right adrenal gland. It may be that the procedure could follow pyelography in the order of performance of the various roentgen studies.

Seven roentgenograms.

THEODORE E. KEATS, M.D.
University of California, S. F.

Meconium Ileus. A Clinical Study of Twenty Surviving Patients. Harry Shwachman, Charles V. Pryles, and Robert E. Gross. J. Dis. Child. **91:** 223–244, March 1956. (H. S., 300 Longwood Ave., Boston 15, Mass.)

Meconium ileus is said to account for about 15 per cent of intestinal obstructions occurring in the neonatal period. The authors studied 20 patients who had been relieved of the obstruction either by surgical (15 cases) or medical (5 cases) means.

The majority of infants with meconium ileus show pulmonary symptoms during the first few months of life. In the authors' series such symptoms were present in all but 3 instances. Roentgen examination reveals uniform changes in the lungs, varying only in degree of involvement. These consist of irregular aeration, increased bronchovascular markings, lobular or less commonly lobar atelectasis, emphysema, and bronchiectasis, occasionally with peribronchial infection. Once the intestinal obstruction has been relieved, it is upon the severity and rate of progression of the pulmonary involvement that the prognosis depends.

Special attention to this aspect was paid in appraising the present status of the 20 patients in this series.

In 3 patients, aged five, two and a half, and three and a half years, pulmonary symptoms were absent and roentgenograms were normal. Six patients, ranging in age from two and three quarter to eight and a half years, showed mild pulmonary involvement, with minimum emphysema and atelectasis. Moderate pulmonary involvement, consistent with normal or near-normal activity, was present in 7 of the group, from six months to over thirteen years of age. In these cases chest films showed diffuse atelectasis and emphysema and increased vascular markings. In 2 children, both under five years, the condition was classed as severe, with widespread areas of involvement demonstrable roentgenographically. The 2 remaining patients could not be definitely classified but were considered to fall between the moderate and severe groups.

The formation of thick mucus in the lungs presents a challenging therapeutic problem. The infectious process may be controlled for long periods. In general there is a progression of the pulmonary changes without therapy, but that early pulmonary changes are reversible is well illustrated by 1 of the reported cases.

Although this report is not overly optimistic, the survival of these 20 patients helps dispel the completely gloomy attitude toward meconium obstruction.

Ten roentgenograms; 4 charts; 8 photographs; 2 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Radiology of the Inflamed Small Intestine. Functional and Organic Signs of Inflammatory Disease. E. Chérigié. J. de radiol. et d'électrol. **37:** 133–144, March-April 1956. (In French) (Paris, France)

Inflammatory disease affecting the small intestine may give rise to abnormal roentgen signs due to functional or organic changes. Functional aberrations include changes in motility, tone, segmentation, and retention of gas and fluid. Organic changes are secondary to edema, hypertrophy of lymphatic follicles, ulceration, fibrosclerosis, and adhesions.

Hypertrophy of the ileal lymphatic follicles is common in the infectious diseases of children, typhoid fever, and regional ileitis. Tuberculous enteritis may also present hypertrophic lymphatic follicles, as well as diffuse ulceration, granuloma of the ileocecal region, stenotic areas, and irregular loops gathered together, as in peritoneal tuberculosis. Functional changes include dilatations, spasm, and collections of gas or gas and fluid.

Regional ileitis may produce hypertrophy of lymphatic follicles, irregular stenosis of the intestinal wall, and fistulas, and there may be associated functional changes.

In typhoid fever the lymphatic follicles may be hypertrophied, and ulceration and perforation in the ileocecal region may occur. Functional changes include dilatation of the jejunum, ileus, and segmental spasm.

Some conditions produce chiefly functional changes, notably sprue, diarrhea, and avitaminosis. Modification of motility, segmentation, and gas and fluid retention are common. When these conditions are present for a long time, atrophy of muscle, ulceration, or stenosis may eventually occur. Some of the changes may become irreversible.

Twenty-four roentgenograms.

CHARLES M. NICE, JR., M.D.
University of Minnesota

Multiple Lipomas of the Ileum. John W. Findley, Jr., and William H. Thompson. Gastroenterology **30:** 500–502, March 1956. (J. W. F., Jr., 23 Baldwin Ave., San Mateo, Calif.)

A small-intestinal roentgenographic examination of a 64-year-old woman complaining of diarrhea and abdominal cramps for five years revealed multiple smooth polypoid tumors confined to one segment of the ileum. Peristaltic waves passed over the area and some of the tumors were propelled by peristalsis. Thirty-two centimeters of ileum was resected and 12 distinct submucosal lipomas were found within 21 cm. This is believed to be the first report of multiple lipomas of the small intestine in the literature.

Two roentgenograms; 1 photograph.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Pneumatosis Coli. Richard H. Marshak and Joan Eliasoph. Am. J. Digest. Dis. **1:** 99–107, March 1956. (R. H. M., 1075 Park Ave., New York, N. Y.)

Pneumatosis coli is a rare disease manifested by intramural collections of gas in the colon and its peritoneal attachments. The primary form occurs without apparent cause, with diffuse involvement of the bowel wall and mesentery. The more common secondary form is frequently related to some lesion of the gastrointestinal tract such as ulcer or neoplasm. The gas pockets are found in the intestinal wall and are most often visible over the serosal surface of the bowel. The muscularis is rarely involved. Microscopically, the mucosa is intact. The cysts are considered to be dilated lymph channels filled with gas and lined by endothelial cells, with occasional giant cells. Complications, such as pneumoperitoneum, intestinal obstruction due to compression of the bowel lumen by cysts, and volvulus have been observed when a similar process occurs in the small intestine and ileocecal region. These have not been noted with left-sided pneumatosis coli.

Pneumatosis coli is usually asymptomatic, being discovered incidentally. A scout film of the abdomen may reveal an unusual cluster of gas shadows, which may be grape-like in pattern or may simulate a normal intestinal picture. Barium studies of the colon will show that these shadows lie adjacent to the intestinal lumen and indent its contours. The defects may extend into the mesentery, and the mucosal pattern may be distorted. The segments of bowel involved may not be continuous.

Several etiologic theories have been proposed for pneumatosis coli: neoplastic, mechanical, and traumatic. The mechanical theory is applicable to cases in which there is an associated gastrointestinal lesion with a mucosal defect and possibly obstruction. According to this theory, the gas under higher intraluminal pressure is forced through the mucosal defect into the submucosa and serosa and dissects along the mesenteric lymphatics to a site distant from the original lesion, producing secondary pneumatosis intestinalis.

In pneumatosis involving the left side of the colon, a specific cause has not been definitely established. In 5 previously reported cases there was a history of trauma

incident to sigmoidoscopy, mucosal biopsy, and rectal surgery, and in 3 of the 4 cases presented in this report pneumatosis involving the sigmoid followed sigmoidoscopy. The authors conclude that, in left-sided pneumatosis coli at least, there is a very definite relationship to recent sigmoidoscopy and/or biopsy.

Twelve roentgenograms.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Acute Pneumocholecystitis. Carl J. Heifetz. Am. J. Surg. **91:** 449–451, March 1956. (Division of Surgical Services, Jewish Hospital, St. Louis, Mo.)

The total number of recorded cases of pneumocholecystitis is brought up to 52 with the report of a new example. The diagnosis is established by the finding of a radiolucent shadow within the gallbladder. In the upright position a fluid level may be seen. The symptomatology is the same as in the usual case of cholecystitis. Usually organisms of the *Clostridium welchii* group are found.

One roentgenogram.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Biliary Tract Studies. I. X-Ray Diffraction Analysis of Gallstones; Correlation with Occurrence of Microspheroliths in Bile. Kerrison Juniper, Jr., and William E. Woolf. Am. J. Med. **20:** 383–391, March 1956. (VA Hospital, Atlanta, Ga.)

When bile is examined microscopically, tiny, laminated spherules resembling minute gallstones are sometimes seen. They have been found in association with liver disease, and also with pigment gallstones in hemolytic anemias. The mechanism of their formation is not understood.

In an effort to determine their significance, if any, the authors examined the bile and gallstones from a number of patients and autopsy cases by x-ray diffraction analysis. When possible, the various layers of laminated gallstones were examined separately.

It was found that calcium carbonate, calcium pigment complexes, or cholesterol may be components of the microspheroliths. Their formation is associated with increased calcium concentration in gallbladder bile, increased pigment excretion in hepatic bile, and other unknown changes which affect the solubility of calcium in the bile.

The presence of microspheroliths in duodenal drainage bile suggests that calcium-containing stones may be forming within the gallbladder. The finding of pigmented microspheroliths indicates increased biliary pigment excretion and is suggestive of hemolytic anemia.

Three diffraction patterns; 4 photomicrographs; 2 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Evaluation of Oral Cholecystography in Liver Disease. William Mandel, L. M. Gaines, Jr., and R. J. Marilley, Jr. Arch. Int. Med. **97:** 335–339, March 1956. (Medical Department, 3345 U.S.A.F. Hospital, Chanute Air Force Base, Ill.)

It has been stated that cholecystography is contraindicated in the presence of liver disease with jaundice, since under these circumstances it cannot be determined whether failure of visualization is to be attributed to the liver condition or to disease of the gallbladder. In an attempt to clarify this problem the authors have correlated the serum bilirubin level, the retention of sulfobromophthalein (Bromsulphalein) following oral administration, and gallbladder visualization in 40 patients with hepatic disease.

It is concluded that the presence of liver disease with jaundice is not in itself a contraindication to cholecystography. It is the degree and not the type of hepatic disease which determines whether the liver can extract the medium from the blood stream and transfer it to the biliary tract.

Though rigid rules cannot be established, a sulfobromophthalein retention below 20 per cent and a total serum bilirubin value lower than 5 mg. per 100 ml. should not interfere with gallbladder visualization. With sulfobromophthalein levels from 20 per cent to 30 per cent and serum bilirubin values from 5 to 10 mg. per ml, there may or may not be impaired visualization. Values above these levels are not usually compatible with good gallbladder filling.

Serial studies with a double dose of the medium are recommended when the gallbladder is not visualized. If visualization does not occur as the liver function tests return toward normal, extrahepatic disease may be held responsible. The failure of gallbladder visualization in mild or moderate hepatic disease is probably of extrahepatic origin. Oral cholecystography may thus be helpful in differentiating extrahepatic from intrahepatic causes of jaundice.

Unsuspected cholelithiasis may be found as the cause for or concomitantly with the liver disease if cholecystography is performed more frequently in the jaundiced patient.

Five tables.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

The Negative or Faint (Weak Contrast) Cholecystogram and the Diagnosis of Cholecystitis. E. Gaebel. Fortschr. a. d. Geb. d. Röntgenstrahlen **84:** 295–304, March 1956. (In German) (Strahleninstitut der Allgemeinen Ortskrankenkasse Köln, Köln, Germany)

With the introduction of improved contrast media such as Telepaque and Cholografin, failure of gallbladder visualization occurs less often than formerly. Even in cholecystitis a normal cholecystogram is now obtained with increasing frequency. Normal visualization of the gallbladder without stones can thus be compatible with a diagnosis of cholecystitis when localized tenderness exists. On the other hand, faint visualization or non-visualization may be due to various causes other than cholecystitis.

For the evaluation of a negative or faint cholecystogram, the following *technical factors* have to be considered: (1) Fluoroscopic observation and spot films in the erect posture usually reveal a denser contrast than a prone view and may, therefore, change an original faint visualization to normal. In the fasting patient, ordinary bile will accumulate in the gallbladder and that containing the contrast substance will pass into the duodenum. Such a situation can be remedied by a fatty meal prior to cholecystography. This will cause the gallbladder to empty its old contents and permit the entrance of opaque material.

Faint or non-visualization in oral cholecystography may be due to *extrahepatic factors*. Diseases of the digestive tract, such as pyloric stenosis, will result in faulty absorption of the medium. In enteritis, which is occasionally associated with cholecystitis, hypermotility, with rapid passage through the small intestine, will leave no time for absorption of the opaque material.

When poor or non-filling is due to these factors, the intravenous method will result in a normal visualization of the gallbladder.

Intrahepatic factors must also be considered. (1) When the blood is oversaturated with contrast material, the overflow will be excreted by the kidneys, even in the absence of liver disease. (2) When the opaque material is absorbed but not excreted by the liver, opacification of the liver will take place. (3) Liver damage can be excluded when the contrast medium is seen in the bile ducts or in the small intestine.

Faint or non-visualization of the gallbladder can be due to changes in the *biliary system*. (1) Disturbed motility may result in by-passing or rapid emptying of the gallbladder. This can be corrected by administration of morphine. (2) Small concrements in the cystic duct or gallbladder neck, adhesions, and shrinking of the gallbladder may prevent visualization, as can (3) mucosal thickening of the gallbladder wall and of the cystic duct, especially in association with icterus.

Faint or non-visualization is distinctly suggestive of cholecystitis when associated with localized tenderness and when confirmed by the intravenous method. When Cholografin also fails to produce visualization and contrast material appears in the small intestine, obstruction of the cystic duct is to be suspected.

In cholecystitis there should be markedly delayed emptying of the gallbladder, but duodenitis and diseases of other adjacent organs must be excluded. In large but faintly visualized gallbladders atony must be differentiated from hydrops. The latter causes distinct tenderness, indents the duodenum, and fails to respond to a fatty meal. The atonic gallbladder, on the other hand, barely indents the duodenum and responds slowly to the fatty meal.

The author emphasizes the importance of confirmatory re-examinations and the exclusion of all other possibilities before cholecystitis is diagnosed on the basis of faint or non-visualization of the gallbladder.

ERNEST KRAFT, M.D.
Newington, Conn.

Operative Cholangiograms. A Critical Review of Their Value. John D. Adams and R. D. Noel. Virginia M. Monthly **83:** 116–119, March 1956. (Clifton Forge, Va.)

In an effort to assess the value of operative cholangiography, the authors reviewed a group of 263 patients with biliary tract disease undergoing surgery in the course of a three-and-one-half-year period. In 20 instances, cholangiography was not performed, and in 17 the procedure was unsuccessful. Among the 226 cases remaining, 188 cholangiograms were normal and 38 were abnormal; exploration was undertaken in 20 of the latter cases. A comparison of the present group with a similar series of cases, studied prior to the use of cholangiography, disclosed the following: Choledochostomy was undertaken in 15.6 per cent of patients in the earlier series and in 9.4 per cent of those undergoing cholangiography; disease was found in 60 per cent of the earlier group, and in 71.4 per cent of the present series; recurrences developed in 2.5 per cent of the first group, and in none of the patients undergoing cholangiography; deaths occurred in 3.1 per cent of the earlier series, and in 1.77 per cent of the present group.

The authors believe that routine operative cholangiography, in affording greater assurance as to the effectiveness of reconstructive surgery, in decreasing the number of injuries to the common duct, and in facilitating evaluation of intrahepatic biliary tumors or stones and congenital anomalies, is a valuable adjunct to biliary tract surgery.

Three roentgenograms; 1 drawing; 2 tables.

Interpretation of the Intravenous Cholangiogram. Robert E. Wise and Richard G. O'Brien. J.A.M.A. **160:** 819–827, March 10, 1956. (R. E. W., 605 Commonwealth Ave., Boston 15, Mass.)

With the advent of the intravenous use of sodium iodipamide as Biligrafin in Germany and as Cholografin in America the study of the extrahepatic biliary system has received great impetus. This paper reports the authors' experience in 300 examinations: 40 c.c. of the 20 per cent solution was used in 270 cases and 20 c.c. of the 40 per cent solution in the remaining 30. No difference was found between the two concentrations other than the greater ease in handling of the smaller volume.

All 300 examinations were done because of suspected biliary tract disease. Visualization was obtained in about 85 per cent of the cases, there being little variation in the figure for cholecystectomized patients. Within a wide range, liver function tests—serum bilirubin levels and sulfobromophthalein retention—could not be counted on for accurate prediction of visualization or non-visualization. There appeared, however, to be little use in attempting cholangiography in patients with serum bilirubin values above 4.0 mg. and in those with sulfobromophthalein retention of over 40 per cent.

One of the criteria for the interpretation of the films is the diameter of the common bile duct. In proved cases, the range for the normal unobstructed duct was from 3 to 15 mm., while in cases of obstruction it was from 8 to 30 mm. Tabulating these measurements against the number of visualized ducts shows that in 57 per cent of the cases the diameter of the duct was of no value in determining the presence or absence of obstruction. This finding led to the study of another criterion of duct obstruction which the authors consider of prime significance, namely, the length of time the ducts remain opacified, along with the degree or density of the opacification. When the density is not significantly less after two hours than at one hour, partial obstruction of the distal end of the common bile duct may be assumed. The presence of visible contrast medium in the duodenum does not preclude partial obstruction. Total obstruction leads to non-visualization and a marked degree of obstructive jaundice.

At surgery, 14 patients proved to have common duct calculi. Prior examination had demonstrated stones in but 7 cases, but partial obstruction was noted in the remaining 7, leading to operation. In only 6 of the 14 cases with calculi was there associated fibrosis of the sphincter of Oddi or of the ampulla of Vater. Thus, if partial obstruction is noted it is not entirely necessary to visualize the calculi to indicate the need for surgery, although planigraphic examination might serve to demonstrate them in suspicious cases.

Common duct stricture was noted in 5 patients. The proximal portion is usually twice the diameter of the duct distal to the stricture. It is in the borderline case of stricture that the examination proves most useful, since with severe stricture there are jaundice and hepatic damage precluding visualization.

In addition to the size of the duct and the length of time the medium is retained other diagnostic criteria are significant. The obstructed duct is more tortuous and

the hepatic radicles more blunted than in a normally patent duct. The visualization of a short segment may indicate a stricture or a calculus high in the duct.

Morphine was found to contract the sphincter of Oddi and interfere with the time-density relationship of the medium in the duct. The drug was used rarely and only for specific indications. Amyl nitrite had no appreciable effect on emptying of the duct.

Sodium iodipamide was used intravenously in the study of 34 patients in whom oral cholecystography showed little or no filling of the gallbladder. In 8 of the 12 gallbladders thus visualized, stones were present; the other 4 appeared normal. In the remaining 22, in which the gallbladder was not demonstrable, there was good visualization of the ducts. Twelve patients of this latter group came to operation: 10 showed obstruction of the cystic duct, 1 carcinoma of the head of the pancreas, and 1 a cholecystojejunal fistula. Good visualization of the ducts and failure to see the gallbladder would thus indicate cystic duct obstruction. However, in an isolated instance of this type the gallbladder was well seen on a twenty-four hour film, indicating the need for a delayed film on this group of patients.

Intravenous cholangiography affords good visualization of cystic duct and gallbladder remnants. In 1 case calcified cystic duct sutures were misinterpreted as calculi. Another possibility of error is failure to recognize the pyelogram which is usually obtained in the first ten minutes. One instance of retention of the medium within a dilated duct for two hours, interpreted as obstruction, was found to be due to a cholecystoduodenal fistula.

Although the most obvious use of intravenous cholangiography is in visualization of common duct calculi, the authors found early in their experience that determination of the presence or absence of partial obstruction of the duct was of considerably greater importance. It is obstruction to the free flow of bile through the common duct, whether this be due to calculi, stricture, fibrosis of the sphincter of Oddi, or other cause, that gives rise to symptoms in biliary tract disease.

Eight roentgenograms; 2 graphs; 7 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

The Use of Iodipamide Methylglucamine (Cholografin High Potency) as a Contrast Medium for Intravenous Cholangiography. J. Edward Berk, Harry Z. Mellins, and Marvin Brodie. Am. J. M. Sc. **231:** 289–293, March 1956. (J. E. B., Wayne University College of Medicine, Detroit, Mich.)

This article is an evaluation of Cholografin High Potency (E. R. Squibb & Sons), a 52 per cent weight per volume solution of the methylglucamine salt of N,N, adipyl-bis (3 amino-2:4:6 triiodobenzoic acid) with a pH range of 6.0 to 6.5. It is supplied in 20-c.c. ampules which contain the equivalent of 40 c.c. of the 40 per cent solution of Cholografin or the German Biligrafin. Cholografin High Potency is rapidly excreted by the liver following intravenous injection and is principally eliminated in the feces. Less than 10 per cent is excreted through the kidneys except in the presence of hepatic impairment, when a much larger proportion appears in the urine. The preparation is of low toxicity.

The authors studied 82 cases with this new medium. The amount used was 20 c.c., except for 3 cases in which this dose was doubled. Three systemic reactions were observed, all following the larger dose. One patient receiving 20 c.c. had a relatively severe reaction lasting seven hours. The symptoms included syncope and spasm with chills and nausea. All the patients recovered.

The degree of opacification of the biliary ducts following 20 c.c. of Cholografin High Potency was found to be at least equal to that obtained with 40 c.c. of ordinary Cholografin. Visualization of the extrahepatic biliary tree was achieved in some patients with hepatic impairment.

PAUL MASSIK M.D.
Quincy, Mass.

Advantages and Disadvantages of the Morphine Effect Combined with Biligrafin Examination. A. Boris and P. Lörinc. Fortschr. a. d. Geb. d. Röntgenstrahlen **84:** 305–311, March 1956. (In German) (A. B., Chazar A. u. 16, Budapest XIV, Hungary)

Biligrafin (Cholografin) studies have proved to be useful but, even with a double dose, have failed to result in demonstration of the biliary system (1) in patients with diminution or absence of excretion by the liver, (2) in the presence of a choledochojejunostomy or other biliary fistulae, and (3) in severe obesity. Defective closure of the sphincter of Oddi and disturbing gas and feces will also prevent satisfactory visualization. These latter failures, however, can be corrected by the administration of morphine, which causes sphincter spasm and thereby insures a continuous filling of the biliary tract, with increased density. This will allow sufficient time for cleansing enemas and for supplementary views, including tomograms, without the danger of contrast fading.

Morphine injections are indicated when bile ducts are not distinctly visualized and when the presence or absence of duct stones cannot be determined with any degree of certainty. The following routine procedure has been established: 40 c.c. of Cholografin (20 per cent) is injected and roentgenograms are taken twenty, thirty, and forty minutes afterward. When bile ducts are not visualized, 1.0 c.c. of morphine 1 per cent is then injected. Its effect lasts one hour but is noted as early as one minute, and is optimal after fifteen to twenty minutes.

The following disadvantages of the use of morphine after injection are mentioned: (1) disturbing side-effects, with nausea, vomiting, and colic; (2) disturbed function of the ducts, which necessitates re-examination without morphine to exclude dyskinesias; (3) undesirable effect on the gallbladder. The latter will become distended and will fail to shrink even after fatty meals. Because of this effect, the auxiliary morphine method is suitable only for postcholecystectomy cases and is no longer used by the authors when the gallbladder is still present.

Three tables.

ERNEST KRAFT, M.D.
Newington, Conn.

Basic Combined Cholecystangiography. David J. Mitchell. Brit. J. Radiol. **29:** 133–138, March 1956. (Royal Albert Edward Infirmary, Wigan, Lancs., England)

As it is now possible to demonstrate the gallbladder by the oral method and to visualize the hepatic and common ducts consistently by intravenous cholangiography, the author suggests that the two methods be

combined to demonstrate the entire biliary tract. He followed this procedure in 100 cases, unselected except for the exclusion of patients with clinical signs of jaundice.

Patients were given 3 gm. of Telepaque after a fat-free meal the evening before the examination. A single radiograph of the gallbladder area was obtained eleven hours later. Biligrafin (20 c.c.) was then injected intravenously and a radiograph was obtained in thirty minutes, followed by a fat meal and a final film in another thirty minutes. This routine was modified as indicated, but proved successful in over 95 per cent of the cases. It was found that the period between the injection of Biligrafin and radiography could be reduced to twenty minutes with equal effectiveness and that the interval after the fatty meal could be reduced to ten minutes.

No significant toxic reaction occurred in this series. Cystic duct filling in the absence of gallbladder filling was obtained in 4 patients with calculi in the cystic duct. Six cases showed ducts of abnormally large caliber, in all of which there were calculi either in the gallbladder or ducts. Duct calculi were demonstrated in 9 per cent of the 100 cases and probably could not have been diagnosed so conclusively preoperatively by any other method.

Fifteen roentgenograms; 3 tables.

JOHN F. WEIGEN, M.D.
Palo Alto, Calif.

THE SPLEEN

Roentgenologic Diagnosis of Ruptured Spleen. C. C. Wang and Laurence L. Robbins. New England J. Med. **254:** 445–449, March 8, 1956. (Massachusetts General Hospital, Boston, Mass.)

The clinical signs and symptoms are often sufficient for the diagnosis of rupture of the spleen. Typically there is a history of trauma to the left lower chest or upper abdomen, followed by pain in the left upper quadrant radiating to the left shoulder. If rupture is delayed, its possibility may not be recognized until its sudden occurrence leads the patient into precipitate shock.

The authors reviewed the roentgenologic findings in a group of 33 patients with ruptured spleen seen in the ten years between 1945 and 1955 at the Massachusetts General Hospital. In 2 of the 5 cases reported here, there was delayed rupture, in 1 after a lapse of six days and in the second five weeks following the initial trauma.

The x-ray signs helpful in the diagnosis are described in their order of frequency among the 33 patients of the series. There was complete or partial loss of the splenic outline in 31 patients, as seen on the recumbent film. Enlargement of the splenic shadow, due to a localized collection of blood around the organ, with or without intracapsular hematoma, occurred in 19. The size of the spleen was estimated by the position of the stomach bubble, the left hemidiaphragm, and the gas-containing splenic flexure. In 25 patients there was complete or partial obliteration of the left kidney shadow and in 19 obscuring of the homolateral psoas shadow. These findings are due to associated retroperitoneal hemorrhage or edema. In only one-half of the cases did the edema or hemorrhage extend into the gastrolienal ligament to produce localized indentation and serration of the greater curvature of the gastric fundus. When the condition of the patient allowed, fluoroscopic examination revealed limitation of motion of the left hemidiaphragm. Slightly more than one-fourth (27 per cent) of the patients showed fracture of the left lower ribs. Inferior displacement of the left kidney was observed on the recumbent film or by contrast study in 6 cases.

Infrequent findings, of little diagnostic significance, were gastric dilatation (3 cases) and a slight right-sided lumbar scoliosis. Intra-abdominal hemorrhage, a usual concomitant of rupture of the spleen, is difficult to appraise. Haziness of the viscera and widening of the spaces between the intestinal loops may be the sole sign and then indicative only of a large amount of intraperitoneal blood.

Six roentgenograms; 2 photographs.

SAUL SCHEFF, M.D.
Boston, Mass.

HERNIA

Compound Diaphragmatic Hernia: Report of Five Cases. Charles H. Brown, Carl H. Moberg, and Donald B. Effler. Ann. Int. Med. **44:** 534–548, March 1956. (Cleveland Clinic Foundation, Cleveland, Ohio)

Compound hernia is a simple inclusive term used by the authors to describe a specific type of diaphragmatic hernia in which more than one organ has herniated through the involved foramen.

Compound hiatus hernias are extremely infrequent, as are compound diaphragmatic hernias involving the foramen of Morgagni or the foramen of Bochdalek. When such a hernia occurs, however, and a large amount of viscera, including stomach, a portion of the large or small bowel, and a great deal of omentum, enter the thoracic cavity, the patient may suffer severe cardiorespiratory embarrassment, with fatal termination.

Involvement of the colon in non-traumatic diaphragmatic hernia is an uncommon occurrence. The authors present 5 cases of compound diaphragmatic hernia in which the colon was involved, emphasizing the varied manifestations of massive herniation of abdominal contents into the thorax and the difficulties in diagnosis. Symptoms due to herniation of the colon may be those of irritable colon, with gas, bloating, flatulence, constipation, or diarrhea. These symptoms may progress to those of partial obstruction, with cramping abdominal pain. Cardiorespiratory difficulties were severe in all the authors' cases and were easily demonstrated by pulmonary function studies.

Roentgenograms of the chest in cases of massive diaphragmatic hernia frequently suggest the diagnosis, but it is the gastrointestinal examination that is conclusive. This is best made with the patient in the Trendelenburg position. A Valsalva maneuver may be helpful.

In contrast to the simple hiatus hernia, medical treatment has nothing to offer patients with compound massive diaphragmatic hernias that include the colon and other organs. Any attempts at conservative management will result in further respiratory embarrassment. Early surgical correction is indicated, so that respiratory function may be restored to as near normal as possible.

Ten roentgenograms; 2 tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

THE MUSCULOSKELETAL SYSTEM

Acute Hematogenous Osteomyelitis. Morris Green, William L. Nyhan, Jr., and Mildred D. Fousek. Pediatrics **17:** 368–382, March 1956. (M. G., 333 Cedar St., New Haven 11, Conn.)

The case records of 99 children with acute hematogenous osteomyelitis admitted to the Grace-New Haven Hospital from 1924 to 1954 were reviewed. The patient's ages ranged from the post-natal period to fifteen years.

The infection usually begins in the metaphysis of a long bone, where bacteria are trapped in small terminal capillaries with resultant thrombosis, ischemia, necrosis, and abscess formation. Multiple small abscesses may coalesce and extend either toward the medullary cavity or to the overlying cortex, or both. The resistant epiphyseal plate, with its firm periosteal attachment, usually prevents extension into the epiphysis or joint, but these may be involved secondarily; rarely are they the site of primary involvement. The thin cortex of the metaphysis and the loose attachment of the periosteum in this region, particularly in infants, permits the subperiosteal spread of the infection. Where a joint capsule surrounds a portion of the metaphysis as well as the epiphysis, as in the hip, direct joint involvement may follow extension of the process through the periosteum. As the infection progresses, rupture of the periosteum may lead to the development of a soft-tissue abscess. This may occur rapidly, especially in the spongy bone of infants.

Clinically, fever, pain and local swelling coupled with tenderness, limitation of motion and local erythema were the most common findings. The differential diagnosis is difficult, particularly in infants. The presumptive diagnoses in this series covered 11 categories, the most frequent being rheumatic fever. The long bones were involved three times more often than the short; multiple bone involvement occurred in one-fourth of the cases. A history of antecedent illness or trauma was elicited in 70 per cent of the 99 cases, the most frequent being skin infection, in 25 per cent. The Staphylococcus was isolated as the causative organism in 62 patients and in most instances showed hemolytic activity.

Roentgenographic findings are important since they may establish the diagnosis and lead to adequate antibiotic therapy, thus making surgical drainage unnecessary. Unfortunately the typical roentgen changes do not appear until after bone destruction. Soft-tissue swelling with loss of the overlying soft-tissue planes is an early sign and, though non-specific, may lead to the initial suspicion of osteomyelitis. In general the first radiographic sign is the appearance in the metaphyses of one or more areas of radiolucency, usually about ten days after the onset of symptoms. Such areas were noted as the first evidence of the disease in 56 patients in the present series. In 10 cases the first indication was periosteal elevation or new bone formation. The latter may be apparent only in the region of the metaphysis or appear to encircle the entire shaft. Sequestra, as evidenced by dense, sclerotic shadows in the shaft of the bone, appear late.

In infants osteomyelitis may present as a silent swelling of or over a bone and thus be confused with a bone tumor. The final diagnosis may depend upon surgery. In older lesions the lamination of periosteal new bone formation may mimic the onion-skin appearance of Ewing's tumor. Follow-up roentgen studies are of importance once the diagnosis has been established.

The prognosis is discussed and a detailed consideration of therapy is presented.

Four graphs; 10 tables. SAUL SCHEFF, M.D.
Boston, Mass.

Joint and Bone Disease Due to Mycotic Infection. Elam C. Toone, Jr., and John Kelly. Am. J. M. Sc. **231:** 263–273, March 1956. (Medical College of Virginia, Richmond, Va.)

Twenty-five cases of fungous disease were observed in the McGuire Veterans Hospital and the Hospital Division of the Medical College of Virginia between 1949 and 1951, of which 8 showed bone involvement.

North American *blastomycosis* accounted for 11 of the series and for 5 of the cases with bone lesions. The mode of invasion of this single budding, yeast-like cell is unknown. The infection is either cutaneous or systemic. In the systemic form the skin, lungs, and bones are chiefly involved, the latter in over half of the cases. Cancellous bones are more frequently affected than the tubular. The lesion is purely destructive, with no surrounding reactive change. Treatment with stilbamidine and 2-hydroxystilbamidine is effective.

Cryptococcosis has a predilection for the central nervous system, and bone and joint involvement is unusual. It occurred, however, in 2 of the author's 4 cases. The lesions, which appear to have an affinity for bony prominences, are almost purely destructive. Treatment with stilbamidine and 2-hydroxystilbamidine has given encouraging results but is less effective than in blastomycosis.

The remaining case of osseous disease in this series was in a patient with *coccidioidomycosis*. Bone lesions in this condition are manifest as areas of osteolysis. Proliferative periostitis may be present. No therapy is effective.

No instances of bone involvement were observed in 3 cases of *actinomycosis*, 2 of *histoplasmosis*, and 1 of *nocardiosis*.

Pathogenic fungi must be considered in the differential diagnosis of all infections of the bones and joints. Dissemination is by the blood stream except in actinomycosis, which extends directly. The predilection is for cancellous bone. Sequestra are small or absent. To be differentiated are tuberculosis, multiple myeloma, metastatic cancer, and eosinophilic granuloma. Diagnosis can be established only by recovering the organism from the joint, bone abscess cavity, sinus tract, skin, sputum, urine or spinal fluid.

Six roentgenograms; 3 tables. PAUL MASSIK, M.D.
Quincy, Mass.

Hyperostosis Generalisata. Marie Fogel and Rose Fejér. Radiol. clin. **25:** 115–120, March 1956. (In German) (M. F., III. Klinika. Fiumei ut 17. Budapest VIII, Hungary)

The authors present what is considered to be the first report of hyperostosis generalisata occurring in two generations of the same family. In this instance, the patients were a man, sixty-four years of age, and his thirty-four-year-old son. The findings in these cases are described in detail, as well as skeletal studies in a three-year-old grandson. While no outstanding alterations were observed in the boy, the trabecular pattern

just above the acetabulum was found to be somewhat coarser than normal, as compared with another child of similar age and body build.

In its early stages hyperostosis generalisata has few symptoms. There may be easy fatigability and rheumatic complaints. Later, the joints are stiff, and there is radicular pain with possible trophic disturbances. In general, the disease begins in puberty, and its course can be divided into three stages: In the first, hyperostosis and pachydermia predominate and there are few subjective symptoms. In the second phase, after an interval of several years, ligamentous and joint ossification occur. Neurologic symptoms dominate the picture in the third phase, resulting from the pressure of the spinal column osteophytes upon the roots. The appearance of the patient is characteristic: bent-over habitus, large limbs, plump hand and foot joints, clubbed fingers, and cutis laxa.

The bones of the calvarium are either thickened or normal. The petrous bone is sclerotic and the mandible thickened. The sella is normal. The ribs and clavicles are massive, and costovertebral as well as acromioclavicular joints are ossified. The diaphyses of the tubular bones are thickened. These structural osseous changes are characterized by a quantitative increase of endosteal and periosteal bone substance. The compacta is thickened and the marrow narrowed. The trabecular patterns of the epiphyses and metaphyses are characteristically arranged according to the lines of force. The bones are not weakened and undergo no pathologic fractures. Healing tendency is normal.

Laboratory findings, especially serum calcium and phosphorus, are normal.

Six roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

The Ellis-Creveld Syndrome: Report of a Case. Elizabeth K. Turner. M. J. Australia **1:** 366–367, March 3, 1956. (Queen Victoria Memorial Hospital, Melbourne, Australia)

A case of Ellis-Creveld syndrome in an infant who lived for ten days only is presented. It is believed to be the seventh instance of the condition to be reported in the literature. The disease is characterized by ectodermal dysplasia, chondrodysplasia with shortening of the tubular bones of the limbs, polydactyly, and congenital heart disease. The characteristic radiologic findings, which were demonstrated in this case, include shortening of the tibia, fibula, radius, and ulna, among other tubular bones; hypoplasia and ectopia of the proximal tibial ossification centers; peaking of the proximal tibial and humeral shafts; massive fusion of the carpal bones. In the author's case, as in one previously reported, acetabular hypoplasia and *talipes equinovarus* were also apparent.

Three roentgenograms; 1 photograph.

Osteomyelitis and Sarcoma. F. De Witte. J. belge de radiol. **39:** 259–271, 1956. (In French) (Service de Radiodiagnostic de l'Université de Gand, Belgium).

The author presents 4 cases (in patients aged two-and-one-half, three, twelve, and sixty-nine years, respectively) to illustrate the modifying effect of antibiotic treatment on the roentgenologic and clinical aspects of osteomyelitis. These modifications may develop to the point where differentiation of the condition from osteogenic sarcoma, as well as Ewing's endothelioma, becomes increasingly difficult. Since amputation may be a life-saving procedure, the patient should always receive the benefit of early biopsy.

Thirteen roentgenograms.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Incidence of Spina Bifida Occulta in Relation to Age. Wataru W. Sutow and Arthur W. Pryde, with the statistical assistance of Marvin A. Kastenbaum. J. Dis. Child. **91:** 211–217, March 1956. (Laboratories of the Atomic Bomb Casualty Commission, Hiroshima, Japan)

This paper deals with the presence of spina bifida occulta in 540 patients chosen at random from various age groups in Hiroshima during a study of the delayed effects of atomic radiation: 155 were in the seven- to eight-year age group, 95 were twelve years old, 108 ranged from sixteen to eighteen years, and 182 were adults. The diagnosis of spina bifida occulta was made when the roentgenogram showed a distinct unossified gap between the laminae of the neural arch and occasionally when no definite space was demonstrable but there was an indication of lack of continuity of the bony cortex, *e.g.*, overriding of the laminae. The condition appears to have been confined to the fifth lumbar and/or first sacral vertebra.

The incidence of spina bifida occulta involving the fifth lumbar vertebra ranged from 16.1 per cent in the children of seven and eight to 2.2 per cent in the adults, the defect being almost three times more common in males of all ages. For incomplete ossification of the neural arch of the first sacral segment, the range was from 51.6 per cent in the younger age group to 26.3 per cent in adults. The decrease in defects involving both L5 and S1 was from 7.2 per cent to 0.97 per cent. While the incidence of spina bifida occulta reported here is somewhat higher than in similar but larger series in the literature, the greater frequency of the defect in children is consistent with the observations of others.

The literature supports the general impression that posterior fusion of the neural arches of L5 and S1 is complete by five years of age. Thus, the presence of spina bifida occulta has been generally accepted as a distinct developmental defect. The consistently diminished incidence with age and the constant occurrence in both sexes among adults in the 540 cases studied by the authors suggest that in some instances the condition will eventually disappear as development progresses.

Four roentgenograms; 3 graphs; 7 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Tuberculosis at the Site of Spondylolisthesis. A. H. C. Ratliff. Brit J. Surg. **43:** 502–504, March 1956. (Edinburgh Royal Infirmary, Edinburgh, Scotland)

Both tuberculosis of the spine and spondylolisthesis are comparatively common, but seldom are the two diseases found at the same level simultaneously. Three cases are reported in the Norwegian literature, but in none was there radiologic proof of the existence of the interarticular defect prior to the appearance of tuberculosis.

The author presents the case of a fifty-year-old bus driver who had symptomatic spondylolisthesis between the bodies of L3 and L4 in May 1951. He improved with conservative treatment and returned to work a year later. Three months after this, backache recurred.

and typical disk symptoms developed, referred to the level of L3-L4. Roentgenograms showed a destructive lesion of the adjacent surfaces of these vertebral bodies, with more marked narrowing of the disk space than formerly. All other studies were negative. It was assumed that the disease process was tuberculosis superimposed on the previously noted spondylolisthesis, with neural arch defects. The patient was treated by bed rest, streptomycin, para-amino-salicylic acid, and isonicotinyl hydrazide. He improved over a period of eighteen months and went back to work, apparently asymptomatic.

This is believed to be the first case reported with proof that the spondylolisthesis was present before the tuberculous process.

Eight roentgenograms. PAUL MASSIK, M.D.
Quincy, Mass.

Osteochondritis Ischiopubica. Lars R. Holsti. Acta radiol. **45:** 178–184, March 1956. (Roentgen Department, Orthopaedic Hospital of the Invaliidisäatiö, Helsingfors, Finland)

Decalcification, rarefaction, and cystic areas of absorption are the earliest x-ray signs of osteochondritis in the ischiopubic region. Later a cherry-sized swelling develops and projects into the obturator foramen. This has a cloudy, granular appearance, and is sharply demarcated from the normal appearing bone surrounding it. Normal mineralization in this area, however, is sometimes irregular and can duplicate the picture.

The condition develops between the ages of five and nine, at which stage in development the ends of the bones begin to make contact and osseous bridges begin to form between them. Various mechanical agents, as trauma or overexertion, are believed to cause friction between the bone ends and to lead to the formation of the protuberance.

Symptoms in this benign ailment usually develop slowly. There may be pain in the hip or knee or a limp, occasionally with palpable swelling in the groin. These symptoms usually subside promptly with rest. The radiographic changes disappear after six to twelve months.

It is necessary that both x-ray changes and clinical symptoms be present for a diagnosis, as neither alone can be considered diagnostic.

Fifteen cases are reported.

Five roentgenograms. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Radiological Signs of Congenital Subluxation of the Hip, with Description of a New Sign. B. Franchi. Radiol. clin. **25:** 104–114, March 1956. (In French) (Ospedale Civile, Suzzara, Italy)

The author reviews the various roentgen signs of congenital subluxation of the hip.

1. Lines dropped perpendicularly from the lateral margins of the acetabula to a line connecting its medial margins divide each acetabular region into quadrants. Normally, the ossification center for the capital epiphysis should be within the inferomedial quadrant. Departures from this rule are of significance but may, of course, be observed only after the ossification center for the capital epiphysis has appeared.

2. If the most cephalad borders of the femoral necks are connected with a horizontal line, and a line is erected perpendicular to this from the internal border of the neck, the horizontal and vertical distances from the point of intersection to the femur should indicate a measure of upward or outer displacement. If the vertical line is extended upward, it should normally cross the acetabulum at about the middle. According to Putti, this sign of displacement of the superior extremity of the femur is positive only after the first month.

3. The degree of obliquity of the acetabulum is the only sign of diagnostic significance during the first month of life. Direct measurement is difficult. Angles of about 30° are normal; those above 40° are a definite indication of disease. When the acetabulum is abnormally oblique, a straight line connecting the ischiopubic cartilages on either side, if prolonged upward and outward, will either barely touch or avoid the acetabulum.

4. Before the sixth month, hypoplasia of the ossification center for the femoral head should be considered suspicious.

5. The cervico-obturator curve [Shenton's line], normally smooth, is broken. This sign is not trustworthy in cases of minimal subluxation.

6. Laterocranial displacement of the femur may be measured by connecting the iliopubic synchondroses with a straight line and erecting a perpendicular from the highest point of the femoral diaphysis to this first line. The length of the second line, and the distance from its intersection to the synchrondrosis on the first line, indicate the degree of displacement.

[For more information on the diagnosis of this condition, the reader is referred to Lewis, R. W.: Joints of the Extremities. A Radiographic Study. Springfield, Ill., Charles C Thomas, 1955.—C. V. C.]

Four roentgenograms; 7 drawings.
CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Interdigital Sinuses in Barber's Hand. H. D. W. Powell. Brit. J. Surg. **43:** 520–521, March 1956. (The Royal London Homœopathic Hospital, London, England)

This is a brief report of a case in a 54-year-old male, a barber for forty years, who sought advice because of a black spot with swelling in the cleft between the left index and middle fingers. Examination revealed a sinus opening, which was slightly tender. There was no inflammation or node enlargement. One cubic centimeter of iodized oil was injected into the sinus opening and anteroposterior and lateral roentgenograms were taken, confirming the diagnosis. Since conservative therapy was ineffective, the lesion was excised, methylene blue dye being used as a guide to the extent of the involvement. For a complete account of this condition the author refers the reader to Currie, Gibson, and Goodall: Brit. J. Surg. **41:** 278, 1953.

One roentgenogram; 2 photographs; 1 photomicrograph. PAUL MASSIK, M.D.
Quincy, Mass.

OBSTETRICS AND GYNECOLOGY

Roentgen Findings in Genital Tuberculosis in Women. Germaine Ratelle and Jean-Louis Léger. J. Canad. A. Radiologists **7:** 9–13, March 1956. (G. R., Maisonneuve Hospital, Montreal 36, Quebec, Canada)

Tuberculosis of the genital tract in women, though rather uncommon, assumes importance because of the fact that it always occurs during the reproductive period, with consequent sterility. It is invariably a secondary infection, usually originating in the lung. The fallopian

tubes are first involved, with extension to the endometrium. The roentgen study includes: (1) a plain film of the pelvis to visualize any calcification; (2) frontal and oblique views following injection of opaque material under fluoroscopic control; (3) a follow-up film taken several hours later, to appraise tubal patency.

The authors found 5 cases in 1,083 examinations. In this series there were no accidents during or after hysterography. An oily contrast medium was used in most cases. Roentgenograms show (1) straight and rigid tubes with "pipe-like" configuration; (2) multiple strictures of the tubal lumen; (3) fistula-like formations and intramural recesses.

The diagnosis of genital tuberculosis is not always roentgenologically possible but can be made with a high degree of probability in the presence of the findings listed above. The 5 case histories are included.

Twelve roentgenograms. PAUL MASSIK, M.D.
Quincy, Mass.

Pneumoperitoneum in the Diagnosis of Pelvic Disease. Godfrey L. Gale and R. H. Giffin. Canad. M.A.J. **74:** 463–465, March 15, 1956. (Toronto Hospital for Tuberculosis, Weston, Ontario, Canada)

A simple technic involving the use of pneumoperitoneum in the diagnosis of pelvic disease is described. It may be employed in female patients of any age and has been found to be especially valuable in children and unmarried women in whom pelvic examination is difficult. The chief contraindication to the procedure is the presence of peritoneal inflammatory disease, such as tuberculous salpingitis. The radiographic technic is outlined as follows: The patient lies prone on the x-ray table, the head of which is tilted down 50 to 60° to allow the air in the peritoneal cavity to ascend into the pelvis, thus separating the uterus and tubes from the bladder. The x-ray tube is aimed vertically at the floor. Additional oblique views may be helpful. The average factors are those used for a flat film of the abdomen, *i.e.*, 100 ma and 70 kv at 36-inch distance.

Five brief case histories are presented.

Six roentgenograms.

THE GENITOURINARY SYSTEM

The Radiologic Picture of Medullary Sponge Kidney: Review of the Literature and Presentation of Two Cases. Antonio Di Sieno and Bruno Guareschi. Radiol. clin. **25:** 80–103, March 1956. (In Italian) (A Di S., Via Annunciata 7, Milan, Italy)

The authors designate as "sponge" kidney an embryologic defect consisting in the formation of multiple cystic structures of varying size, involving either the whole kidney or only the medulla. The authors' discussion is limited to the latter.

References to this condition are scarce, but it is believed to be much more common than the literature would indicate. It is relatively better known in Italy and in France than elsewhere. Anatomically, it is a cystic dysplasia, of unknown etiology, localized to the renal pyramids. Usually all the pyramids are involved, but the disease may be limited to one kidney or to one or a few pyramids.

The cysts vary in size, some being little larger than the head of a needle. Some are empty, others filled with fluid, organic detritus, or stone. Microscopic examination of the pyramids shows, beside the cysts, normal or dilated excretory tubules, and tubules with diverticular formations. The epithelial lining of the tubules is cylindrical, at times embryonic in appearance. The lining of the cysts is cylindrical, cuboid, or flat. It may be stratified, similar to the mucosa of the calyces. Some of the cysts empty directly into the calyces; most communicate with the collecting tubules. Evidence of infection is seen in all the cases.

The disease is usually silent until complications supervene. Renal function usually shows some diminution, probably due to associated infection. Other complications are hematuria of all degrees and stone formation. Calculosis is found in about one-half of the cases, and usually one sees many small spherical calculi situated within the medullary cysts. At times they are so numerous as to suggest a nephrocalcinosis.

The radiologic appearance is characteristic. Intravenous urography will demonstrate the following in the pyramidal regions: (1) fan-like shadows due to the opacification of the dilated collecting tubules (easily confused with the normal pyelotubular backflow, though in the latter case the shadows are more regular and linear; (2) "bouquet of flowers," caused by dilatation of the collecting tubules associated with microcystic diverticular formations; (3) "bunch of grapes," resulting from sharply outlined cysts of uniform size; (4) mosaic pattern, due to the presence of heterogeneous cysts irregularly distributed within the pyramids. All these changes extend eccentrically, so as to reduce the thickness of the cortex. The authors consider the presence of the second and third type as pathognomonic. A finding not heretofore reported in the literature is the regular enlargement of the papillae and the fornices.

The retrograde examination might show the changes described above more clearly, but at times the cystic lesions are not well filled. Intravenous and retrograde examinations are to be considered complementary.

Among conditions to be considered in the differential diagnosis are: (1) reflux; (2) necrotic papillitis, which is disclosed by enlargement of the papilla with ill-defined borders due to inflammatory edema, irregular forniceal margins, papillary ulcerations, and the typical ring shadow (see Christoffersen and Andersen: Acta radiol. **45:** 27, 1956. Abst. in Radiology **67:** 787, 1956); (3) renal tuberculosis; (4) cysts and pseudocysts communicating with the pelvis.

While essentially good, the prognosis varies according to the nature and severity of the complications, and it is to these that treatment should be directed.

[For recent reports of this conditon in the American literature, see Spence: J. Urol. **74:** 693, 1955; Mulvaney and Collins: J. Urol. **75:** 776, 1956.—C. F. C.]

Six roentgenograms; 3 drawings; 2 tables.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Roentgenologic Findings in Uretero-Appendicular Fistula. Emo Bianchi. Radiol. med. (Milan) **42:** 286–290, March 1956. (In Italian) (Clinica Chirurgica della Università di Padova, Padova, Italy)

Retrograde pyelography, in a sixty-two-year-old female with a painful mass in the right flank, demonstrated a fistula between the middle third of the right ureter and the appendix and outlined the cecum and proximal half of the ascending colon. Barium suspension, introduced by enema, failed to fill the fistula. A radiolucent calculus in the pelvis of the right kidney, with inflammatory changes and mild hydronephrosis,

was also demonstrated. The mass was considered to be due to periureteritis. Heavy antibiotic therapy postponed for two days the fatal outcome of this case, the result of septicemia.

Uretero-appendicular (uretero-cecal) fistula is extremely rare, the author having found only 3 cases previously described in the literature.

Four roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Aneurysm of the Renal Artery. Richard S. Silvis, William F. Hughes, and Francis H. Holmes. Am. J. Surg. **91:** 339–343, March 1956. (U. S. Naval Hospital. Oakland, Calif.)

The authors bring the total number of recorded cases of renal artery aneurysm up to 123 with a report of a case from Oakland Naval Hospital. Symptoms most frequently seen are pain and hematuria. A palpable mass, bruit, and pulsation may also be observed. The most characteristic roentgen finding is a wreath-like, calcified mass in the kidney region. Impaired unilateral renal function is usually present, and pyelograms may show distortion of the renal pelvis or calyces.

The status of the other kidney dictates the method of treatment. If function is adequate, nephrectomy by transperitoneal approach is indicated.

Four roentgenograms; 4 photographs; 4 tables.
GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Hypaque in Intravenous Pyelography. An Analysis of 50 Controlled Examinations Comparing Hypaque with 50 Per Cent Diodone. Brian C. Hale. Brit. J. Radiol. **29:** 158–160, March 1956. (The Middlesex Hospital, London, W. 1, England)

Observations were made on 50 patients undergoing excretion pyelography with Hypaque following examination with Diodone eighteen months earlier. Each patient had received 20 c.c. of 50 per cent Diodone intravenously for the first pyelogram; the same quantity of 45 per cent Hypaque was used on the second occasion. The patients were not aware that the preparations used were different.

Sixteen patients expressed no preference for either Hypaque or Diodone. Of these, 9 had no reaction whatever; the remaining 7 reacted similarly to both media. Thirty-three patients preferred Hypaque and 1 Diodone.

The roentgenograms were examined by three independent observers, who gave their opinions on the rate of excretion, density, and clarity of anatomical detail. The rate of excretion, density of the shadow, and calyceal detail at twenty minutes after the injection of Hypaque were thought in most cases to be better or equal to the results obtained with Diodone.

Three tables. HOWARD L. STEINBACH, M.D.
University of California, S. F.

A Comparative Study of the Value of Sodium Acetrizoate (Diaginol) 50 Per Cent and Sodium Diatrizoate (Hypaque) 45 Per Cent in Intravenous Urography. B. Green and J. G. Sowerbutts. Brit. J. Radiol. **29:** 161–165, March 1956. (B. G., St. Bartholomew's Hospital, London, E. C. 1, England)

Two hundred fifty patients were examined by Diaginol 50 per cent and 500 patients by Hypaque 45 per cent. Some of these had been examined previously with Diodone and all expressed a preference for either Diaginol or Hypaque. With Diaginol, pain in the arm and shoulder were of frequent occurrence. These were ascribed to venospasm, but this was not sufficient to make the patients prefer Diodone. With Hypaque, the local reactions were negligible. The number of cases of flushing and of vomiting and tingling was less with Hypaque than with Diaginol, but other symptoms did not show much variation.

The excretion rate for Hypaque was slightly more rapid than for Diaginol. It is the authors' impression that the contrast produced by these two media was identical; both showed an increase in density as compared with Diodone 50 per cent.

Fourteen roentgenograms; 3 tables.
HOWARD L. STEINBACH, M.D.
University of California, S. F.

Report on 1028 Cases of Intravenous Urography with Sodium Acetrizoate (Diaginol) as Contrast Medium. P. Cave, G. A. Burfield, and J. A. Rankin. Brit. J. Radiol. **29:** 166–168, March 1956. (Diagnostic X-ray Department, Royal Berkshire Hospital, Reading, Berks., England)

Trials of sodium acetrizoate (Diaginol) in 30, 50, and 70 per cent solution for routine intravenous urography in 1,028 cases showed that, whereas the last produces the best radiographs, the 50 per cent solution is only slightly inferior, and the 30 per cent solution more so. Side-effects, nearly all trivial, occurred in 35, 33, and 49 per cent of patients injected with the 30, 50 and 70 per cent solutions, respectively.

Possessing most of the advantages of the other two solutions, the less well known 50 per cent preparation has proved to be the most desirable for routine intravenous urography.

Two tables. HOWARD L. STEINBACH, M.D.
University of California, S. F.

Nephrography During Routine Excretory Urography. Arnold M. Wald. J. Urol. **75:** 572–577, March 1956. (United Hospital, Port Chester, N. Y.)

Twenty-five cubic centimeters of 70 per cent Urokon injected intravenously in ten to fifteen seconds with an 18 gauge needle produced good nephrograms in 64 of 100 patients studied. With the patient in the Trendelenburg position a 14 × 17-inch film was exposed thirty seconds after the beginning of the injection. The patient was then given a cup of water and the conventional pyelographic series was completed. No serious reactions followed the injection. Oral antihistamines were given routinely prior to the examination.

Four roentgenograms; 3 tables.
RICHARD E. BUENGER, M.D.
Chicago, Ill.

THE ADRENALS

Generalized Xanthomatosis with Calcified Adrenals. A. Abramov, S. Schorr, and M. Wolman. J. Dis. Child. **91:** 282–286, March 1956. (Hadassah University Hospital, Jerusalem, Israel)

This paper reports in detail the occurrence of widespread xanthomatosis with a normal blood cholesterol level in a two-month-old female infant. The striking finding during life was the x-ray appearance of diffuse calcification replacing most of the adrenals. The lipid could not be further identified, despite chemical and

physicochemical studies pre- and postmortem. The authors postulate that the calcification in this case was due to saponification by calcium of the fatty acids released by hydrolysis of cholesterol esters.

The differential diagnosis of adrenal calcification in infants should include adrenal hemorrhage, generalized xanthomatosis, tuberculosis associated with Addison's disease, and new growths such as neuroblastoma, ganglioneuroma, and carcinoma of the adrenals associated with scattered flecks of calcified tissue. In cases other than those due to hemorrhage or xanthomatosis, the calcification is less widespread.

Three roentgenograms; 5 photomicrographs.

SAUL SCHEFF, M.D.
Boston, Mass.

MISCELLANEOUS

Combined Intravenous Cholecystography and Pyelography. N. H. Aldridge. Brit. J. Radiol. **29:** 127–132, March 1956. (The General Infirmary, Leeds, England).

The aim of the combined examination described by the author is to obtain an adequate radiologic study of the urinary and biliary systems after the administration of two media at a single injection. Biligrafin and Diodone were used. Toxicity studies indicated that the mixture of the media was actually slightly less toxic than either alone.

Twenty cubic centimeters of each preparation was administered together with one large syringe one and one-half hours following a fatty meal. The entire examination was completed in one and a half hours. This period does not exceed that required for intravenous cholecystography alone, but the almost undivided attention of a technician is required.

The method is useful for complete radiological examination of both renal and biliary systems within the shortest possible time and is recommended for (1) patients with vague upper abdominal pain referable to either system, particularly where rapid diagnosis is required, and (2) for out-patients who have made a long journey or who for other reasons find multiple visits inconvenient.

Thirteen roentgenograms; 1 graph; 1 table.

JOHN F. WEIGEN, M.D.
Palo Alto, Calif.

Air Embolism During Presacral Pneumography: A Case Report. Irving Glassman, Robert Shapiro, and Franklin Robinson. J. Urol. **75:** 569–571, March 1956. (Hospital of St. Raphael, New Haven, Conn.)

Attention is called to the possibility of air embolism following presacral pneumography. In the case reported, two injections of 300 c.c. of air were made in a seventy-year-old patient in the knee-chest position, for investigation of an abdominal mass. Cyanosis and chest pain were transient following the first injection and were treated by placing the patient in the left lateral decubitus position. Coma followed the second injection. This was treated similarly, and oxygen was administered. Hemiparesis, semicoma, and convulsions followed for the next twelve hours. Recovery was complete in five days.

One drawing.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

RADIOTHERAPY

Treatment of Cancer of the Nasal Cavity and Paranasal Sinuses. James W. Hendrick. Surg., Gynec. & Obst. **102:** 322–330, March 1956. (332 Encino Ave., San Antonio 9, Texas)

Neither radiation therapy nor radical surgery, utilized alone, is capable of bringing about a high percentage of cures of cancer of the paranasal sinuses. A combination of methods should result in a higher survival rate and at the same time produce fewer complications.

The author reports on a series of 72 cases. For none of these could any definite etiologic factors be discovered. Lymph-node involvement generally occurred late in the course of the disease; extension was usually by direct invasion of adjacent structures. Squamous-cell cancer was by far the most common.

In the nasal fossa, radium may be used for anteriorly placed lesions at the mucocutaneous junction. For more posterior tumors standard deep therapy is used if they are extensive and radiosensitive. Surgery is the treatment of choice for radioresistant lesions. For extensive disease, radiotherapy followed in six weeks by operation is indicated. The x-ray dose is 3,000 to 4,000 r in two to three weeks.

Even for advanced cases in the paranasal sinuses, irradiation and surgery are advocated. The author describes his method of radical surgery, with exenteration of the orbit and electrocoagulation and curettage for lesions invading the ethmoid and sphenoid sinuses and pterygoid fossa. Radium needles may be left in place in the wound if the areas are believed to contain residual tumor. A dose of 6,000 to 10,000 r at 1 cm. is given. Radical neck dissections were rarely performed.

One roentgenogram; 4 photographs; 5 drawings.

HAROLD L. ATKINS, M.D.
University of Pennsylvania Hospital

The Treatment of Skin Tumors of the Inner Canthus with Regard to the Function of the Lacrimal Ducts. Hansrudolph Renfer. Strahlentherapie **99:** 345–353, March 1956. (In German) (Röntgeninstitut der Universität und des Inselspitals, Bern, Switzerland)

Superficial tumors of the inner canthus of less than 3 cm. diameter were treated with 50-kv roentgen rays, filtered with 1 to 2 mm. Al, at 22 or 42 mm. T.S.D. The daily dose was 500 r in air, to a total of 6,000 to 7,000 r. For larger and deeper, infiltrating lesions, the factors were 100 to 150 kv, 2 to 3 mm. Al filter, 15 to 30 cm. T.S.D., 300 r in air daily to a total dose of 3,600 to 4,200 r. Twenty-five cases (16 basal-cell carcinomas, 7 "spinocellular" carcinomas, 1 "spinocellular" sarcoma, 1 unverified tumor) were treated, and a five-year cure was achieved in 85 per cent. The lacrimal duct function remained good in nearly all cases and the cosmetic results were favorable. In 5 cases in which higher single doses were delivered at greater intervals, stenosis or complete obliteration of the lacrimal ducts occurred.

Nine photographs; 1 drawing; 1 table.

LEWIS L. HAAS, M.D.
Chicago, Ill.

Indications for Radical Surgery, Partial Surgery, Radiotherapy and Combined Surgery and Radiotherapy for Cancer of the Larynx and Hypopharynx. Jean Leroux-Robert. Ann. Otol., Rhin. & Laryng. **65:** 137–153, March 1956. (147 Rue de la Pompe, Paris XVI, France)

At the Curie Foundation, some 800 patients with cancer of the larynx and hypopharynx have been operated upon during the past eighteen years, 350 at least five years prior to this report. Five hundred and twenty-five patients with cancer of the pyriform sinus were treated by irradiation alone; 13 were given a combination of surgery and irradiation. Analysis of this material led to formulation of the following therapeutic indications.

For *cancer of the vocal cord*, surgery is preferred over radiotherapy in all instances. The author makes the good point that a radiotherapist must be much better qualified technically for treating cordal cancer by irradiation than the surgeon for performing a thyrotomy.

For *subglottic cancer*, surgery is said to fail less often than radiation therapy. Postoperative irradiation is unnecessary because of the low incidence of lymph node invasion in this disease.

Cancer of the *ventricle* is best treated by total laryngectomy, with routine postoperative radiotherapy.

Cancer of the *ventricular bands and laryngeal surface of the epiglottis* (laryngeal vestibule) is also best treated by laryngectomy with postoperative irradiation. Lymph node metastases are very common. Radiotherapy alone has been successful in some cases. Surgery alone has usually failed.

For cancer of the *suprahyoid portion of the epiglottis* which does not extend into the marginal folds irradiation is the treatment of choice. If surgery is done, it should be followed by radiotherapy.

Treatment by surgery or combined surgery and irradiation, as outlined above, has resulted in 118 five-year cures in 200 laryngeal cancer cases. The author emphasizes the value of partial laryngeal surgery with preservation of the voice when feasible.

Cancer of the *pyriform sinus* shows much better results when surgery is combined with radiotherapy than when either is used alone. Cancer of the entire pyriform sinus is the type most frequently seen. Here total pharyngolaryngectomy is done after 1,500 to 1,800 r have been given preoperatively. Postoperatively, dosage is carried to cancerocidal levels. In the presence of a single mobile node or a group of mobile nodes less than 3 cm. in diameter, total pharyngolaryngectomy with *en bloc* cervical dissection is followed by a full course of x-ray therapy. With fixed nodes, multiple nodes, or large nodes (over 3 cm. in diameter), radiotherapy is preferred over surgery for treatment both of the primary lesion and the metastases. Occasionally local excision of a remaining node may be done afterward, if the primary lesion has responded well.

Six figures. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Supervoltage Roentgen Therapy in Cancer of the Lung. T. A. Watson. Am. J. Roentgenol. **75:** 525–529, March 1956. (City Hospital, Saskatoon, Sask., Canada)

This paper reports on 611 cases of cancer of the lung diagnosed in the Saskatchewan Cancer Clinics from 1932 to 1953.

Three hundred and nineteen patients were untreated. Of these, 14 were alive at the time of the report, with an average survival of fifteen months. Two untreated patients had lived between three and four years. For those who died, the average survival was 3.1 months.

Patients receiving roentgen therapy were ordinarily inoperable, with far advanced disease, although perhaps not so far advanced as in the untreated category. Of this group of 151 patients, 5 were still alive, with an average survival of twelve months. The average survival of the dead in this group was 5.7 months, indicating that the only appreciable effect of x-ray therapy was a greater number of survivals in the early months. Actually this may be related to the terminal state of the untreated patients rather than the treatment *per se*.

The group of 28 patients who were treated with the betatron unit showed the highest survival rate in the early period. The average period of survival of those who died was eight months and there were 5 patients alive after an average of twenty months.

Of 15 patients treated with cobalt 60, 7 were alive at the time of writing, with an average survival of 7.6 months. For the dead, the average survival was 5.9 months.

It was interesting to note that a combined therapeutic regimen involving roentgen therapy and nitrogen mustard enhanced the survival time of those who died to 9.9 months as compared to 5.7 months with roentgen therapy alone and 4.6 months with nitrogen mustard alone.

Of the morphologic tumor types, the epidermoid carcinoma was attended by the longest survivals.

Since the radiotherapist encounters the less favorable cases of lung cancer, palliation is the purpose of treatment. Results of the different forms of therapy are tabulated as to subjective and objective (reduction in tumor size) relief. Among those treated with nitrogen mustard only, improvement was observed in only 14 per cent. When roentgen therapy was employed, 42.5 per cent demonstrated subjective and/or objective improvement. When roentgen therapy and nitrogen mustard were combined, 72 per cent experienced improvement. Of betatron-treated and cobalt-treated patients 75 per cent and 79 per cent improved, respectively.

For betatron irradiation, large fields including the primary tumor and more than half of the mediastinum on the same side were employed for delivery of a dose of 5,500 to 6,000 r in eighteen to twenty days, or 7,500 r in thirty to thirty-five days. Only 14 cases were treated with the cobalt unit, and a tumor dose of 4,500 r in seventeen to twenty days was obtained in most of these. The author's experiences indicated that palliation was more marked with treatment with the betatron than with the cobalt unit.

On the basis of these figures, it is suggested that supervoltage therapy offers significant palliation in cancer of the lung.

One graph; 6 tables. JOHN W. WILSON, M.D.
Johnstown, Penna.

Radiation Therapy of Carcinoma of the Esophagus. K. Schärer. Strahlentherapie **97:** 508–513, August 1955. (In German) (Röntgendiagnostischen Zentralinstitut und der Radiotherapeutischen Klinik der Universität Zürich, Zürich, Switzerland)

Seven-hundred and twenty-four cases of cancer of the esophagus were treated at the Department of

Radiation Therapy of the University of Zürich between 1919 and 1951. The present study is concerned with 225 patients seen in the period from 1943 to 1951.

Seventy patients were treated with conventional deep x-ray therapy, with half-value layers of from 1 to 2 mm. Cu and a tumor dose of 6,000 to 7,500 r, through four to six portals, while 155 patients were given approximately the same tumor dose with rotation therapy. Fourteen received an additional dose of radium, administered internally in loaded rubber tubing.

Carcinomas of the upper third of the esophagus were found to respond most favorably to treatment, the average survival period for 56 cases being thirteen months. The author reports 5 apparent cures resulting from the use of radiation alone, 1 for three years, 2 for four years, 1 for six years, and 1 for seven years.

Cancers of the middle third of the esophagus respond less well to radiotherapy, but are not regarded as hopeless. The average survival period for 111 cases was 8.6 months, with 3 patients living for three years, 2 for four years, and 1 for seven years.

For 58 patients with cancer of the lower third of the esophagus, the average survival period was 8.6 months, 2 patients living for six and seven years, respectively.

Clinically, 53 per cent of all the patients either became worse or failed entirely to respond to irradiation; 36 per cent showed some improvement over a period of a few weeks or months; in 4 per cent local cures were achieved but death resulted from distant metastases; 5 per cent of the patients survived for three years, and 2 per cent for five years. A slight increase in the number of cures was observed, as compared with the effects of treatment in previous years.

The author concludes that the results of radiotherapy are about the same as those of surgery and that further improvement may be anticipated with the availability of supervoltage equipment.

Three tables. EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Radiation Combined with Surgery in the Treatment of Rectal Neoplasms in Various Stages. P. Gambaecini. Radiol. med. (Milan) **42:** 251–281, March 1956. (In Italian) (Istituto di Radiologia dell'Universitá di Firenze, Firenze, Italy)

The treatment of carcinoma of the rectum is discussed, with a review of the literature and presentation of 21 cases. Biopsy is essential in distinguishing the common, well differentiated adenocarcinoma from the relatively radiosensitive epidermoids or undifferentiated adenocarcinomas. Whenever feasible, abdominoperineal resection is the treatment of choice. Although, even in good hands, the mortality may be between 6 and 10 per cent, the procedure has resulted in five-year survivals in 40 to 50 per cent of selected (clearly operable) cases. Preoperative irradiation is considered unnecessary in these latter patients; it is occasionally used to reduce the size of a large tumor to the point where it becomes amenable to surgery. Conversely, the author considers that postoperative irradiation is always desirable (to control the tumor residue not removed at surgery), since it is supposed to increase the five-year survival rate by 15 per cent.

For the cases which are inoperable by virtue of local extension, distant metastases, or poor general condition of the patient, irradiation has significant value. Contact roentgen therapy associated with external deep therapy is advocated when the tumor is not more than 15 cm. from the anus, when it is not infiltrating, stenosing or ulcerated, and not larger than 4 × 8 cm. This treatment could result in a five-year survival rate of 55 per cent under "favorable" circumstances. Special applicators are used for contact therapy, and the surface dose (cited from the French literature) may be as high as 60,000 to 80,000 r.

External deep therapy, as administered by the author, was through four 8 × 8- or 8 × 10-cm. ports, at 50 cm. T.S.D., with a Thoraeus 3 filter, h.v.l. 2.8 mm. Cu, 200 to 250 kvp, 8 to 15 ma; 300 r (presumably measured in air) are given daily to alternate ports (a fifth, perineal port was added when necessary). In several cases, there is reference to a "total dose" of 12,000 r, which seems to apply to the sum of air doses given to all ports, *i.e.*, about 3,000 r (in air) per port. This dose is within the limits of skin tolerance, but little mention is made of rectal mucositis, an inevitable feature under the circumstances.

Intracavitary radium sources are no longer used except for large polypoid or fungating tumors. Interstitial radium needles are recommended only for small anal epidermoids.

Recently, supervoltage and rotational methods have been employed in the irradiation of carcinoma of the rectum. From a survey of the literature, it would seem that these procedures could increase the five-year survival by another 5 per cent. The author has just started using rotational therapy, and the present report was published so as to have the material at hand for future comparison.

Sixteen roentgenograms; 4 photomicrographs; 2 photographs; 2 drawings; 2 tables.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Treatment of Endometrial Adenocarcinoma. A Study of 381 Cases at the New York Hospital. A Preliminary Report. Carl T. Javert and R. Gordon Douglas. Am. J. Roentgenol. **75:** 508–514, March 1956. (C. T. J., 530 E. 70th St., New York 21, 1956)

Three hundred and eighty-one patients seen during the years 1932–54 form the basis of this report. The authors feel that "surgery, either alone or followed by definitive, rational postoperative radiotherapy designed to prevent or reduce the clinical incidence of 'recurrence' is the procedure of choice" in the management of this disease. Data are presented in tabular form to show results of various forms of surgical and radiotherapeutic management of cases at their institution. Tabulation is made according to a surgical-pathological classification showing the distribution of cases in Stages 0, I, II, III, and IV.

One hundred and sixty-one patients were treated by surgery alone; 178 by surgery plus some form of radiotherapy; only 26 by irradiation alone. It appears that only cases with obvious extrauterine spread at the time of initial therapy were managed by irradiation. Patients with small or superficial tumors underwent hysterectomy as the definitive treatment, followed by irradiation only if there was evidence in the surgical specimen of contiguous spread or metastasis to lymph nodes. In this series the highest incidence of metastasis occurred in patients who received preoperative radium either alone or followed by surgery. [It is not stated whether these were the cases with the most advanced disease initially.] The authors use this evidence to refute the idea that preoperative irradiation followed by

hysterectomy will reduce the incidence of vaginal vault recurrence.

A study of patterns of tumor spread indicates that carcinoma of the endometrium spreads not only by lymphatic channels but has a prominent hematogenous metastatic form as well. Adeno-acanthoma was found most prone to metastasize to the vagina. Such metastasis presaged an unfavorable course: 80 per cent of the patients were dead within five years.

A comparison of the authors' follow-up results with those reported by Heyman for primary radium therapy is made, and the statistical evidence given here seems to favor the authors' series.

Arguments against the routine use of preoperative radium in management of endometrial carcinoma are summarized. The most important seems to be that approximately 50 per cent of these tumors are superficial and hence presumably curable by hysterectomy alone, while those showing invasion of the deep myometrium or adjacent tissues are not controlled by current methods of radium or external roentgen therapy.

Thirteen tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Dose Decrease in Bladder and Rectum in Gynecologic Radium Treatments. August Verhagen. Strahlentherapie **99:** 442–447, March 1956. (In German) (Städtischen Frauenklinik, Essen, Germany)

By vaginal tamponade with strips of gauze 5 to 10 in. in length, during radiotherapy of cervical cancer, the uterus and radium containers may be so shifted in position that the distance from the rectum and especially from the bladder is increased, with significant decrease in radiation in these areas.

One diagram; 1 table. LEWIS L. HAAS, M.D.
Chicago, Ill.

The Phosphamidase in Cells of Vaginal Smears in Cervix Carcinoma Before and After Radiotherapy. Peter Sepp. Strahlentherapie **99:** 393–399, March 1956. (In German) (II. Universitäts-Frauenklinik, München, Germany)

The author describes a method of cytologic study which he admits is very difficult but may, after improvements in the technic, prove practicable for the diagnosis of cervical carcinoma and the follow-up of irradiated cases. It consists in determining the ferment activity of the cells in vaginal smears, by the Gomöri reaction. In 60 cases examined, tumor cells showed marked phosphamidase activity in the nucleus, and less marked in the protoplasm. After irradiation, this activity decreased, the reactions becoming weaker or disappearing.

One photomicrograph. LEWIS L. HAAS, M.D.
Chicago, Ill.

Therapy of Carcinoma of the Urinary Bladder. Ira H. Lockwood and Samuel B. Chapman. Am. J. Roentgenol. **75:** 519–524, March 1956. (I. H. L., 830 Argyle Building, Kansas City, Mo.)

A program is outlined for the handling of patients with carcinoma of the bladder, and the following points are emphasized: A definitive diagnosis must be made with the radiologist and surgeon acting as a team. It is the surgeon's responsibility to obtain adequate biopsy, provide adequate drainage of urine from the bladder, and combat vigorously any infection that may be present. After the primary mode of attack is agreed upon, an all-out effort must be made for control of the tumor at the first treatment course. The authors feel that all patients with carcinoma of the urinary bladder should be given the benefit of radiotherapy whether or not there is evidence of local extension. A tumor dose of 6,000 r is the goal and may be delivered by any combination of external roentgen therapy, radium, and radon. In most instances in this series, the mainstay of therapy was external irradiation (h.v.l. 2.8 mm. Cu) through six pelvic ports, with daily increments of 300 to 400 r (air). It was not felt that complications frequently cited in the literature occurred unduly often nor that they constitute a strong argument against vigorous radiotherapy.

A series of 103 consecutive cases of carcinoma of the bladder treated by radiotherapy as the primary agent are reported and analyzed. The five-year cure rate appears to be between 29 and 43 per cent, depending upon the statistical method of analysis. All patients received deep roentgen therapy to the maximum of tolerance. A few were given localized second or third treatment series, without apparent undue incidence of complications.

A discussant, T. A. Watson, expresses the opinion that a tumor dose of 6,000 r seems very high, particularly if used over additional radium or radon seed implantation and with a beam of no higher quality than 200 kv. He also questions such radical external irradiation for cases of non-infiltrating papilloma of malignant type.

Four tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

A Study of 2678 Patients with Initial Carcinoma of the Bladder: I. Survival Rates. II. Survival Rates in Relation to Therapy. F. K. Mostofi, with the statistical assistance of Mary S. Levitin and Jean H. Gerende. J. Urol. **75:** 480–491; 492–500, March 1956. (Armed Forces Institute of Pathology, Veterans Administration, Washington, D. C.)

Records of 2,678 patients with primary bladder tumors showing no evidence of metastasis at the time of initial treatment were selected from the Bladder Tumor Registry of the Armed Forces Institute of Pathology. Only those patients treated in 1945 or earlier and those surviving the initial treatment were studied. Tumors were graded according to size, microscopic differentiation, multiplicity, and invasiveness.

Survival and five-year "tumor-free" rates varied greatly with the type of treatment within each grade of tumor. For the more advanced grades and for the infiltrating type of lesion, better results were obtained by open surgery combined with radiation. Closed surgery and radon produced better results in the papillary types of lower grade. In 131 patients treated by segmental resection alone, five-year survivals and "tumor-free" rates were better in almost all grades than in 148 patients treated by radon alone.

Nine graphs. RICHARD E. BUENGER, M.D.
Chicago, Ill.

The Treatment of Urethral Tumors. R. H. Flocks. J. Urol. **75:** 514–526, March 1956. (University Hospitals, Iowa City, Iowa)

The author's observations on the treatment of urethral tumors are based on results reported in the literature and on 17 cases treated at the University of Iowa Hospitals, 1935–55. Therapy varies with the sex

of the patient, the location, extent and histology of the tumor, and the presence or absence of metastases.

For urethral carcinoma in the male, surgery is the basic procedure, including removal of the nodes in the inguinal region and femoral canal. Radiation therapy of regional nodes should be considered if, because of extensive involvement or infection, operative removal is not indicated. Inguinal hypogastric, iliac and presymphyseal nodes should be irradiated. The tumor in these nodes has been found to be fairly radiosensitive.

Small tumors of the distal female urethra may be treated by local excision and/or radiation (radon or radium) locally and x-ray therapy to the regional lymph nodes. The usual more advanced tumor should be treated, as in the male bulbomembranous urethra, by radical local excision, diversion of the urinary stream, and lymphatic dissection.

Palliative therapy is an individual problem, involving urinary stream diversion, x-ray therapy, and chordotomy.

Six drawings; 3 photographs; 8 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Teleroentgentherapy in the Treatment of Neoplastic Metastases. G. Nadolny. Fortschr. a. d. Geb. d. Röntgenstrahlen **84:** 336–342, March 1956. (In German) (Röntgen-Therapie-Abteilung des Krankenhauses der Augustinerinnen Köln, Köln, Germany)

In addition to the conventional type of radiotherapy, the author has used teleroentgentherapy when metastatic lesions were widespread. He considers this technic to be indicated when the extent of the disease or the condition of the patient precludes either surgical measures or ordinary roentgen irradiation.

The following technical factors are cited: 200 kvp, 0.5 mm. Cu filter (1.1 mm. Cu h.v.l.), 100 to 160 cm. distance (for smaller fields 60–80 cm), 50 to 60 r daily five times a week for a total of 30 to 50 treatments. The single dose, if not well tolerated, may have to be reduced to 25 r. Up to three series per year can be given, with intermissions of eight to twelve weeks.

Occasionally, a roentgen reaction occurs during the first week, which usually disappears later on. The blood has to be checked each week, since leukopenia may develop. When the white cell count drops to 2,000, treatments should be interrupted; the count usually does not fall below this level, even when irradiation is resumed.

Teleroentgentherapy is considered solely a palliative measure. It affords relief of pain in all instances and occasionally may lead to marked improvement of health, with ability to work again for a period of years. The author recommends the simultaneous use of hormones and castration in cancer of the breast, which constitutes the majority of his material. Because of these additional therapeutic measures, a valid statistical evaluation cannot be made.

Four cases of metastases from mammary carcinoma, mostly in the skeleton, are briefly reported. Serial roentgenograms illustrate regression and re-ossification of multiple osteolytic bone lesions and healing of pathologic fractures, with formation of dense callus. In addition to skeletal metastases, pulmonary metastatic lesions, pleuritis carcinomatosa, and ascites have been successfully treated with teleroentgentherapy.

Eight roentgenograms.

ERNEST KRAFT, M.D.
Newington, Conn.

Therapy of Malignant Lymphomas. I. A Study of 116 Cases. II. A Review. Charles A. Hall and Kenneth B. Olson. Am. J. Med. **20:** 392–398, 399–411, March 1956. (Albany Medical College, Albany, N. Y.)

In the first of these papers the authors present the results in 116 cases of malignant lymphoma treated in the Albany Hospital in 1940–50. The series includes Hodgkin's disease and lymphosarcoma, but the leukemias are excluded. Several patients who received only nitrogen mustard were followed for periods up to six years.

The course of the disease was apparently the same when nitrogen mustard was used as the sole method of treatment as when x-ray therapy was used. When the patient was resistant to one treatment form, he proved also to be resistant to the other. The same thing was found to be true regarding sensitivity.

When both x-ray therapy and nitrogen mustard were used during the course of the illness, the first agent employed was usually the more effective. The two appeared to be similar in mode of action.

In the final analysis, it appears that results have not been significantly improved by the addition of nitrogen mustard in the treatment of lymphoma.

In the second paper the authors review the literature on malignant lymphoma with a view to comparing the results of others with their own and thus evaluating the various methods of treatment.

In Hodgkin's disease surgery is necessarily restricted to cases in which the process is localized. It appears not to have proved superior to simple x-ray therapy. In localized lymphosarcoma or reticulum-cell sarcoma, equally good results can apparently be obtained with either form of therapy.

Roentgen therapy produces symptomatic improvement, and occasionally has apparently cured cases with a localized primary focus. Whether or not it prolongs the life of other patients with Hodgkin's disease or lymphosarcoma has not been proved. Which technics of x-ray therapy are preferable cannot be established from the reports in the literature.

Nitrogen mustard has been used more for generalized than for localized Hodgkin's disease. It appears to have about the same effect as x-rays. The remissions brought about by irradiation are slightly longer, however, and it is more effective in the reduction of tumors.

TEM (triethylenemelamine) produces its response more slowly than does nitrogen mustard, but otherwise no basic difference in effect has been shown between the two. The effect on survival has not been evaluated.

ACTH and cortisone have reduced tumor size and relieved symptoms in a few lymphoma cases. Results have not been consistent, however, nor are they comparable with those achieved by roentgen therapy, nitrogen mustard, or TEM.

Finally, a plea is made for more uniformity of case study methods in the future, so that treatment results may be more reliably evaluated.

Seven tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Lymphosarcoma: Clinical Picture, Therapy, and Prognosis. Experiences of the Department of Radiation Therapy of the University of Zürich from 1936 to 1951. Adolph J. Gretener. Strahlentherapie **97:** 514–548, August 1955. (In German) (Radiotherapeutischen Klinik und Poliklinik der Universität Zürich, Zürich, Switzerland)

A total of 66 cases of lymphosarcoma were seen at the

Department of Radiation Therapy of the University of Zürich between 1936 and 1951. The series comprised 45 males and 21 females, the majority of patients being between the ages of forty and seventy years.

In view of the radiosensitivity of lymphosarcomas, the treatment of choice was intensive local irradiation or, in some instances, surgery followed by irradiation. The average tumor dose with conventional deep therapy was 2,250 to 2,400 r. The results of therapy for the series were as follows: three-year survival rate 42 per cent and five-year survival rate 33 per cent; 26 per cent of patients without symptoms for three years, 21 per cent for five years. The most favorable results were obtained in lymphosarcoma of the stomach and the peripheral lymph nodes; results were poor in patients with mediastinal involvement or with generalized spread of the disease. Nitrogen mustard therapy proved to be of no value.

The histopathology and symptomatology of the condition are discussed in detail. Three stages are distinguished, as follows: Stage I, localized tumor confined to the lymphatic system, with occasional regional metastases to the nodes; State II, hematogenous metastases to closely related organs (lymph nodes and spleen); Stage III, generalized metastatic spread. Stages II and III cannot be cured with present methods of radiotherapy, and are subject to palliation only. The course of the disease is important to the prognosis. About 50 per cent of the lesions grow and spread rapidly, and in such cases the prognosis is poor. For the slowly progressive type, the outlook is decidedly better.

One graph; 7 tables.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

A Report on the Use of Convergent Beam X-Ray Therapy. G. E. Flatman and R. E. Ellis. Brit. J. Radiol. **29:** 139–147, March 1956. (Meyerstein Institute of Radiotherapy, Middlesex Hospital, London, W.1, England)

This report on the use of convergent beam x-ray therapy is based on experience in the treatment of 192 patients. The rotating x-ray tube, mounted on a spiral track, moves so that the central beam axis passes continuously through the center of a sphere of 45 cm. radius. The spiral movement takes place over the surface of a cap of this sphere of half-angle 36 degrees. The unit may be fitted with four different cones which allow the convergent point tissue depth to be varied from 7 to 14.5 cm.

Two methods of treatment have been used: (1) convergent beam therapy (full-cone irradiation), in which a complete spiral traverse from the center to the outside is used; (2) peripheral convergent beam therapy (hollow cone irradiation), with the tube starting from the extreme periphery and moving inward for one minute's irradiation and then being reversed for one minute, back to the periphery again.

In clinical use, two opposing fields are treated, separated by 15 to 24 cm. Central dosages are usually 140 to 300 per cent of the maximum skin doses. This method enables larger and deeper volumes of tissue to be irradiated. The unit is used at 200 kv, 20 ma, with a half-value layer of 1 mm. of copper.

The convergent beam unit has the advantage that small volumes can be accurately localized and irradiated to high dosage with relatively small dosage to surrounding tissue, especially the skin. A disadvantage is the limitation of depth and volume which it is possible to irradiate. Tumors in the head and neck and pelvis are most suitable. There appears to be a relatively milder constitutional reaction than when treatment is given by other technics and conventional voltage. Mucosal reactions are often brisk, and treatment rate has been limited to 900 r per week at the 200 per cent isodose level.

Isodose curves for the individual portals and examples of dosage distribution in specific patients are excellently presented.

Three roentgenograms; 1 photograph; 13 figures; 1 table.

JOHN F. WEIGEN, M.D.
Palo Alto, Calif.

The Therapeutic Use of Single Doses of Total Body Radiation. Vincent P. Collins and R. Kenneth Loeffler. Am. J. Roentgenol. **75:** 542–547, March 1956. (V. P. C., 1200 M.D. Anderson Blvd., Houston, Texas)

For generalized neoplastic disease, drug therapy has been used widely in lieu of total-body irradiation. The authors found previously (Science **118:** 161, 1953) that total-body irradiation in single doses up to 150 r was less depressing for hematopoiesis and produced less malaise than nitrogen mustard and triethylene melamine administration. In view of this, it was hoped that a therapeutic effect could be obtained through total-body irradiation in patients with disseminated disease ordinarily receiving chemotherapy.

Reported are 5 cases of disseminated lymphoma, chronic myelogenous leukemia, and multiple myeloma treated by 150 r (skin dose) to 200 r (skin dose) total-body irradiation in one sitting. The factors employed were 250 kv, h.v.l. 2.3 mm. Cu, target-skin distance 360 cm.

From a symptomatic point of view, the reaction to single doses up to 200 r was less than would be anticipated with conventional doses of nitrogen mustard, and the hematopoietic depression was acceptable as compared with that due to the latter agent. Response of the disease and subjective relief from pain would indicate that a single dose of total-body irradiation has definite therapeutic significance. It is pointed out that any form of therapy in generalized neoplastic disease is aimed at palliation only and any beneficial effects of therapy must be weighed against undesirable side effects, the length of the treatment, and the latent period before any response obtains. In all of these respects single-dose total-body irradiation offers some advantage.

It is concluded that this form of treatment should be used as an additional form of therapy in the management of advanced disseminated cancer.

Two roentgenograms.

JOHN W. WILSON, M.D.
Johnstown, Penna.

Time-Dose Relationships. Lucille A. Du Sault. Am. J. Roentgenol. **75:** 597–606, March 1956. (Henry Ford Hospital, Detroit 2, Mich.)

It has long been recognized that the effect of a given dose of radiation varies according to the time in which it is delivered and that this variation is not similar for all tissues.

The time-dose relationships may be varied in three ways: (1) the intensity, or r per minute, (2) the overall treatment time, and (3) the degree of fractionation or time interval between treatments.

It has been shown that within reasonable limits the effectiveness of radiation does not vary with the intensity of the individual treatments. Various experimental and clinical data indicate, however, a definite relationship of the overall treatment time to the effectiveness of given quantities of radiation. The advantages of protraction of treatment are illustrated by the time-dose relationships and recovery exponents of squamous-cell carcinoma of the skin, cervix, and larynx in comparison with similar data for adjacent normal tissues. In these instances, protraction enhances the therapeutic ratio. This advantage does not obtain for adenocarcinoma of the breast and uterus, however, where the skin effect is the limiting factor.

In her discussion of the effect of fractionation, the author presents a curve showing the dose effect in relation to the time at which a second treatment is added. If, after an initial treatment, a second dose is given during the latent period (*i.e.*, before any response to the initial therapy is detected), the effect will simply be the sum of the two doses. If the second dose is given after the latent period and during the recovery period, its effect will depend upon how much of the initial dose remains effective, which in turn is a function of the overall time, the effective amount becoming less as the time is extended. If a second treatment is administered during the recovery period, it must be increasingly enlarged as the time progresses to produce a given effect. If a second dose is delivered after recovery ceases, it will have the same effect regardless of the time at which it is administered, and the dose required for the given effect will be the same. Thus, in a series of treatments, successive doses may fall in the recovery period or the post-recovery period depending upon the time interval between any two treatments. With fractionation over a protracted period, therefore, successive treatments will fall into the recovery periods of immediately preceding treatments and, as a result of the cumulative dose effect, there will be a lowering of the total dose required for long overall periods. This means that the straight line iso-effect on logarithms of dose and time would ultimately assume a sigmoid shape which may be a clue to optimum overall time selections.

The significance of the recovery cycle with respect to time-dose relationships lies in the fact that, if recovery is more rapid in normal than in tumor tissue, then treatments timed so that each falls into the recovery period from the preceding treatment or treatments will result in a lower slope for the cancerocidal time-dose line than for the normal tissue tolerance line, with consequent advantage of extension of overall time. Tissues with identical recovery but different radiosensitivity would have parallel time-dose lines regardless of fractionation, and extension of the overall time would have no advantage. If the tumor recovery is more rapid than normal tissue recovery, extension of the overall time becomes a disadvantage. In the latter circumstance, if the treatments could be timed beyond the recovery phase, the cancerocidal curve might be lowered and, if this timing still brought the treatments in the recovery phase of the normal tissue, its time-dose curve would not be changed. Thus a relative therapeutic advantage would be obtained.

It is pointed out that the effect of timing is not only dependent upon the recovery cycle but upon variable radiosensitivity in different periods of the life cycle of the cell and the interaction of various other factors (chemicals, temperature, hormones, etc.). Collectively these may account for the periodicity of radiation effects.

It is concluded that there is much to be learned regarding the time-dose relationships and particularly the fractionation effect. Further enlightenment should result in improved technics of treatment.

Six figures. JOHN W. WILSON, M.D.
Johnstown, Penna.

Application of the Paterson-Parker System in Interstitial Radium Therapy. Fernando G. Bloedorn. Am. J. Roentgenol. **75:** 457–475, March 1956. (M.D. Anderson Hospital and Tumor Institute, Houston, Texas)

Despite more common use of new radiotherapeutic technics—supervoltage, rotation therapy, etc.—certain cancers are still best treated by interstitial radium application.

The author's study is concerned with: (1) the clinical application of the Paterson-Parker system and the problems involved in the choice of the type of implant in order to give adequate coverage of the lesion; (2) the commonly used method of estimating the dose delivered. A description of the Parker-Meredith-Stephenson method is given. This was chosen because (*a*) it is simple, (*b*) it is usually applicable, (*c*) there is good correlation between measured and calculated doses, and (*d*) it leads to careful study of the films, which results in improvement of implant technics.

A good series of examples with calculations is given, covering a variety of clinical conditions.

[It was observed in the discussion (p. 493) of this paper that it might be considered a Medical Part II to the original Paterson-Parker publication (Brit. J. Radiol. **11:** 252, 1938).—R.A.E.]

Thirty-six illustrations, including 25 roentgenograms.
RICHARD A. ELMER, M.D.
Atlanta, Ga.

A Graphical Method for the Localization of Radium Sources for Dosage Calculation. Morton M. Kligerman, Howard W. Vreeland, and Jan Havinga. Am. J. Roentgenol. **75:** 484–493, March 1956. (622 W. 168th St., New York 32, N. Y.)

Radium dosage calculations require accurate localization of the radioactive sources unless their positions follow closely a pre-arranged plan such as the Paterson-Parker system. Often, such a satisfactory pattern is not accomplished, making it necessary to calculate the dosage rate at several points in the tumor and surrounding tissue.

The authors outline a relatively simple method of obtaining orthographic projections which are free from magnification and distortion. These projections are obtained from routine radiographs made with the usual divergent beam.

One of the authors discusses in some detail the theoretical aspects of the problem and its graphical solution. The remainder of the article deals with the practical application of the localization method. Equipment is described in detail and an allowance of $200.00 is suggested for materials and labor for its construction.

The actual steps in the graphical solution of the problem are given in complete detail in a manner which makes it unnecessary to understand the theory. The time required for localization of an implant of eight needles with three critical points is estimated at one

and a half to two hours, with an error of less than 3 per cent.

Fourteen diagrams. RICHARD A. ELMER, M.D.
Atlanta, Ga.

A Nomographic Wheel for Three Dimensional Localization of Radium Sources and Calculation of Dose Rate. J. Garrett Holt. Am. J. Roentgenol. **75:** 476–483, March 1956. (City of Hope Medical Center, Duarte, Calif.)

The purpose of this paper is to describe a relatively simple, rapid, and reasonably accurate method of calculation of radium dosage in the course of interstitial or intracavitary treatment with linear radium sources. A circular slide rule has been designed to simplify the problem of calculating the dose rates produced by gamma rays from any number of internal radium sources at a given point. This is particularly useful in the treatment of cancer of the uterine cervix where reference points are relatively fixed.

The nomographic wheel provides (1) a measure of the magnified projection of a line on two planes at right angles; (2) a correction for the magnification; (3) a "true" measure of the line by construction of a right triangle, having as its sides the two projections (the interest point and source point must both lie in a plane parallel to one of the two film planes); (4) an automatic reading of the exposure at this distance, with a Quimby table distribution.

A detailed study of the article is necessary for adequate comprehension.

Four roentgenograms; 6 diagrams; 1 table.
RICHARD A. ELMER, M.D.
Atlanta, Ga.

A New Radium Implant Technique to Reduce Operating Room Exposure and Increase Accuracy of Placement. Robert Fishman and Lester I. Citrin. Am. J. Roentgenol. **75:** 495–496, March 1956. (R. F., Mount Auburn Hospital, Cambridge 38, Mass.)

A new method is presented for decreasing the exposure of personnel during radium implantation and achieving greater accuracy of placement. Dummy needles of proper length are cut from stainless steel Kirschner wires and fitted into somewhat longer, thin-walled plastic tubes of suitable diameter. The dummy needles with their sheaths are then placed in the tumor in the usual manner, at the operator's leisure. Roentgenograms of the area are made and positions of the needles checked. Any desired alteration to improve their placement is effected. The dummy needles are then slipped out of their sheaths by traction on pre-placed cotton sutures, while the plastic tubing remains in place. The radium needles are substituted quickly in the pre-arranged position.

By use of this method the authors have decreased by at least one-half the amount of exposure received in previous radium insertions. It is believed that additional experience will cut exposures to the operators even further.

Two roentgenograms; 1 photograph; 1 drawing.
JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Neutron Capture Therapy: Slow Neutron Depth Distribution Measurements in Tissue. E. E. Stickley. Am. J. Roentgenol. **75:** 609–618, March 1956. (Brookhaven National Laboratory, Upton, Long Island, N. Y.)

Neutron therapy is based upon the release of nuclear energy in the intended site of treatment when slow neutrons are captured by a target element. Boron has been used as the target material because of its selective uptake in tumor tissue.

An experiment was set up to calculate the clinical dose in neutron capture therapy. Phantoms were irradiated with slow neutrons from a nuclear reactor source, corresponding to the treatment of brain tumors. Gold foils, which are activated by neutrons, had been inserted at various points, and these were counted for radioactivity after irradiation of the phantom. From the data thus obtained, the neutron flux was calculated. Depth dose diagrams indicate an exponential fall in neutron density along the beam axis; however, the neutrons scatter diffusely in contrast to the pattern of graduations in roentgen-ray depth doses.

The radiation dose depends upon the boron concentration as well as the neutron flux. Where 10^{12} neutrons per sq. cm. are delivered to the skin, at a depth of 2.5 cm., 1 gram of tissue bearing 30 micrograms of B^{10} receives 100 rads of radiation energy. At the same depth, a tissue bearing only 6 micrograms of B^{10} receives 20 rads. This is about one-third the dose received by similar tissues at the surface and about ten times that delivered at the mid-line.

Three photographs; 7 figures; 1 table.
JOHN W. WILSON, M.D.
Johnstown, Penna.

RADIOISOTOPES

Plasma Activity Levels in Radioiodine Tests of Thyroid Function. H. A. Hughes and R. M. Miller. Brit. M. J. **1:** 493–494, March 3, 1956. (H. A. H., Western General Hospital, Edinburgh, Scotland)

The authors have studied the value of the 48-hour total plasma activity as an index of thyroid function, in patients from Southeast England. Eighty patients were investigated, including cases of marked hyperthyroidism, mild toxic goiter and mild exophthalmic Graves' disease, and patients suspected of hyperthyroidism but subsequently judged on clinical grounds to have normal thyroid function.

The authors publish four tables showing their results, including a comparison with other methods of investigation. The 48-hour total plasma activity was found to give reliable results in the diagnosis of hyperthyroidism. The sensitivity of the test is such that an accurate assessment of function cannot be obtained in borderline patients, but there is evidence that a gradation of 48-hour plasma activity exists throughout the intermediate group.

Four tables. JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Cancer of the Thyroid, with Metastases to the Lungs. Condition Shown by Scintigram in Absence of Definite X-Ray Findings. Boris Catz and Paul Starr. J.A.M.A. **160:** 1046–1047, March 24, 1956. (B. C., 1200 N. State St., Los Angeles 33, Calif.)

This paper reports in detail the case of an 11-year-old

Negro boy who had widespread cervical metastases from a multicentric alveolar and follicular carcinoma of the thyroid, proved at surgery. In addition there were multiple metastases in the lungs, which were not detected roentgenographically but were discovered on scintigraphic study six days after a therapeutic dose of 100 mc. of I^{131}. The patient was prepared for the uptake examination by administration of thyrotropic hormone.

During a five-month period two additional doses of I^{131}—92.5 and 92.0 mc.—were given, following which there was no further demonstration of metastatic tissue by the scintigrams.

Thus the administration of the isotope not only served to demonstrate metastases that were unsuspected on the chest films but eradicated the residual tumor in the thyroid and cervical and pulmonary metastases.

Two roentgenograms; 5 scintigrams; 1 table.

SAUL SCHEFF, M.D.
Boston, Mass.

A New Telegamma Apparatus. Bo Lindell and Rune Walstam. Acta radiol. **45:** 236–248, March 1956. (Karolinska Sjukhuset, Stockholm, Sweden)

A radiotherapy apparatus for use with radioactive cobalt has been designed along the same general lines as a conventional teleradium unit.

One departure is the small cylindrical source in this unit. This permits the use of diaphragms to limit the beam size without reducing intensity, which has not been possible in teleradium units, where numerous radium tubes are spread over a relatively large area.

The source is kept in a heavy storage container, to which is attached an arm with a treatment head on its end. A tube runs down the arm so that the source can be pushed into or withdrawn from the treatment head by means of a long spiral wire. Shielding about the arm and head appears to be ample, and is so designed that radiation can be administered in almost any direction.

The unit has several advantages over teleradium units. First, the source is relatively inexpensive, and its intensity allows shorter treatment times and a greater variety of set-ups. It is also believed that the new unit is more safely handled than previous constructions. The small source size preserves field-shape deep within tissues, so that depth dose distribution is more homogeneous within the beam, with less scatter outside the beam.

Clinical results and treatment technics are not discussed.

Sixteen illustrations.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Concerning the Technic of Irradiation with Radioactive Cobalt. Ivo Padovan and Pavao Frank. Radiol. clin. **25:** 72–79, March 1956. (In German) (Oto-Rhino-Laryngologische Abteilung und Onkologisches Institut des Krankenhauses "Dr. Mladen Stojanovic," Zagreb, Yugoslavia)

The authors describe some of their experiences with cobalt 60 beads in treating tumors resistant to methods of irradiation hitherto in use. The beads have a diameter of 6 mm., with a central perforation. Their activity is 8.6–8.9 mc.

For use in epipharyngeal tumors, the beads are arranged serially in a Lastex tube, which is introduced through the mouth into the epipharynx and there held in place by two threads drawn through both nasal openings and fastened in front of the nares. For irradiation of hypophyseal tumors, the Lastex tube containing the beads is passed through the nose, and the positioning is controlled by roentgenograms.

For the treatment of esophageal cancer, the cobalt beads are placed within a rubber sound and introduced through an esophagoscope, the exact position being determined by roentgenograms. The free end of the sound is fastened outside the nose. The patient tolerates this procedure well.

For bronchogenic cancer, the authors thread the beads on a strong but elastic silver thread. This they place within a thin ureteral catheter which is inserted into the bronchus with a bronchoscope, after anesthetization of the mucosa. A similar arrangement is used for cancer of the bladder.

The value of the cobalt 60 bead method is demonstrated in a forty-year-old patient with cancer of the lung. In spite of heavy external irradiation, bronchoscopy during the introduction of the cobalt beads showed a bleeding tumor in the right bronchus. Two months later death occurred from widespread metastases. At autopsy, the bronchial tumor had disappeared and the wall was completely smooth. Nevertheless, there was marked seeding on the pleura, even within the beam of the previously administered external irradiation.

Five roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Experience with Radioactive Colloidal Gold in the Treatment of Ovarian Carcinoma. William C. Keettel and H. B. Elkins. Am. J. Obst. & Gynec. **71:** 553–565, March 1956.

The first part of this paper is concerned with cytological studies to determine if abnormal cells could be detected in fluid removed from the peritoneal cavity or cul-de-sac. In 247 patients fluid aspirated from the cul-de-sac at the time of dilatation and curettage revealed no abnormal cells. Cytologic studies of peritoneal washings at laparotomy in 275 patients gave better results, revealing abnormal cells in 17 instances. Fourteen of these patients had ovarian cancer and 2 extensive uterine cancer. There was 1 false positive. While these cytologic studies were chiefly of academic interest, since the diagnosis was usually obvious from gross inspection, there were 5 cases in which there was no visible evidence of a break-through of the capsule, no free fluid, and no omental or peritoneal implants, but in which abnormal cells were present floating in the peritoneal cavity. It is felt that such dispersed cells may account for the relative frequency of recurrence reported for patients treated by total hysterectomy and ovariectomy.

The second part of the paper describes the authors' present method of management of ovarian carcinoma and summarizes experiences with radioactive gold therapy. Patients with ovarian carcinoma of Stages I and IIA (*i.e.*, cases permitting surgical removal of all of the primary tumor and all visible metastases and cases with ascites with malignant cells or in which malignant cells have been spilled into the peritoneal cavity at operation) are treated with total hysterectomy, bilateral salpingo-oophorectomy, and radioactive gold. Others are treated with surgery, external irradiation, and radioactive gold when feasible. The

majority of the patients tolerate the gold with minimal complications.

Colloidal gold is of value in controlling formation of ascitic fluid in certain patients. Sufficient time has not elapsed to evaluate five-year survival rates, but results are encouraging. The authors' general conclusion is that if the patient is in reasonably good physical condition and has marked ascites, gold should be used; if, however, her condition is deteriorating rapidly or she has severe ileus, gold therapy, even for palliation, is contraindicated.

One drawing; 6 photomicrographs; 10 tables.

R. L. EGAN, M.D.
M.D. Anderson Hospital, Houston, Tex.

Aplastic Anemia Secondary to Intravenous Therapy with Radiogold. Report of a Case. Harold M. Schoolman and Steven O. Schwartz. J.A.M.A. **160:** 461–463, Feb. 11, 1956. (S. O. S., 1835 W. Harrison St., Chicago 12, Ill.)

A case of aplastic anemia following intravenous administration of radioactive gold for metastatic carcinoma of the liver is reported. The patient, a sixty-year-old woman, had previously undergone cecostomy and laparotomy, the latter procedure having revealed the liver involvement. A blood count made subsequent to cobalt 60 therapy showed: hemoglobin, 11.9 gm. per 100 c.c. (77 per cent); red cells, 4,200,000; white cells, 5,500. Progressive weakness and abdominal pain followed the subsequent administration of 50 mc. of Au^{198}, and blood studies showed the hemoglobin to have fallen to 1.8 gm. per 100 c.c. (12 per cent), the red blood cells to 620,000, and white cells to 800 (neutrophils 72, band cells 4, eosinophils 1, lymphocytes 17, monocytes 6). The platelets were reduced in number, and the marrow was found to be extremely hypocellular and fibrotic, with only scattered marrow remnants; megakaryocytes were moderately decreased in number.

Transfusions were given as required to maintain the hemoglobin at approximately 50 per cent. The hemoglobin level did not drop when transfusions were terminated, and sternal aspiration showed a return of the marrow toward normal.

Although irradiation shortens the life span of normal erythrocytes, it is not known to produce an acute hemolytic crisis. In this case, however, such an episode must be postulated, in addition to the known marrow aplasia, to account for the precipitous fall in red blood cell count and hemoglobin levels. The short half-life of Au^{198} (2.69 days) is believed to explain the recovery of the marrow; with exposure to effective radiation for any longer period, the chances of recovery would have been correspondingly reduced. The implied relationship between toxicity and the half-life of the agent is regarded as an important consideration in the choice of media for intravenous administration.

Two photomicrographs.

Clinical Experiences with the Strontium 90 Applicator. Eugene F. Lutterbeck and Irvin F. Hummon, Jr. Strahlentherapie **97:** 568–574, August 1955. (In German) (E. F. L., 185 N. Wabash Ave., Chicago, Ill.)

The authors report a three-year experience with a strontium 90 applicator, first described and designed by Friedell and co-workers (Am. J. Ophth. **33:** 525, 1950. Abst. in Radiology **56:** 792, 1951). They employed it in 80 cases, in 77 patients.

The applicator contains a 40-mc source, with an output of about 38 rep per second; the treatment area has a diameter of 7.8 mm. The effective beta radiation has a maximal energy of 2.16 MEV. There is no gamma component. The depth dose at 1 mm. is 41 per cent, at 2 mm. 19 per cent, and at 3 mm. 9 per cent. The device is most useful in superficial lesions of the cornea, and can be used for leukoplakia, small hemangiomas, and small keloids. Treatments are given at weekly intervals, and the average surface dose varies from 600 to 2,000 rep, depending upon the indications.

Good results were observed in postoperative pterygium, various vascularizations of the cornea, postoperative granuloma, and vernal catarrh. Attempts to treat port-wine marks were unsuccessful. Because of the low depth dose, external beta irradiation is not recommended for cases of epithelial downgrowth or malignant lesions of the globe of the eye.

During the three-year period no lens changes which could be attributed to the radiation therapy were observed.

Five photographs; 2 tables.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Blood Volume Changes in Cases of Cerebral Trauma as Determined by Radioactive Isotopes. Edmund A. Smolik, Raymond O. Muether, Francis P. Nash, and Wilfred Konneker. Surg., Gynec. & Obst. **102:** 263–270, March 1956. (St. Louis University School of Medicine, St. Louis, Mo.)

The authors wanted to determine whether or not acute changes in whole blood volume might be a factor in producing secondary anemia in patients with closed head injuries. Radioactive chromium and radioactive iodinated human serum albumin were used for these determinations. The former was employed to tag a universal donor (RH negative, type O) blood which could be kept available for use in emergency situations, usually associated with head injuries. This procedure also had the advantage that, after a single injection of the isotope, serial determinations could be carried out over a period of several days. Control studies showed the above method to be satisfactory, although in a few cases there was a rapid removal of the tagged cells from the circulation, suggesting that the life of foreign cells in some patients is short.

Some of the patients were studied by means of radioactive iodinated human serum albumin, which gave a direct measurement of plasma volume as well as total blood volume.

In 21 patients in whom the sole factor producing the clinical picture was cerebral trauma, serial blood volume determinations were carried out by the above methods.

Of the 21 patients studied, 17 (80 per cent) showed a significant deviation of the blood volume from the accepted normal, on admission. In 11 patients (52 per cent) there was an initial increase in the blood volume, with a gradual return to normal, generally paralleling the clinical improvement. In 6 of the patients (28 per cent) there was an initial decrease in blood volume. In the remainder (4 per cent) there was no significant change in this respect.

Twelve of the 21 patients (57 per cent) had an anemia

on admission. In 9 of these there was also an increase in the blood volume and, in those cases in which the plasma volume was measured directly, it too was found to be increased. In 5 of these 9 patients there was a less-than-normal total cell volume. Here, a loss of erythrocytes and plasma dilution combined to produce the anemia. In 3 cases, the anemia developed without any increase in the whole blood volume.

Clinically, using the duration of unconsciousness as an index of severity, the authors concluded that patients sustaining severe injury showed a progressive blood volume increase and anemia for several days following the injury. Patients with only moderate injury had a less marked volumetric change and only rarely showed progression of the blood volume changes or anemia. In some cases there was even a constriction of the vascular bed with no anemia.

The authors suggest that these alterations in blood volume are due to disturbances in central vasomotor control, resulting in either generalized vasoconstriction or vasodilatation. The latter is usually associated with the more severe injuries and is a factor in producing anemia. RICHARD E. ERNST, M.D.

Six graphs; 1 table. University of Pennsylvania

RADIATION EFFECTS

Roentgenographic Examinations and Radiation Hazard. J. Camerman. J. belge de radiol. **39:** 165–178, 1956. (In French) (Anvers, Belgium)

The "permissible" weekly total-body exposure of 0.3 r corresponds to 3,500 gram-roentgens (0.05 r × 70,000 gm. average body weight) per person per day. This paper includes a table with the following data, measured or calculated, for most of the routine diagnostic procedures: filtration, target-film distances, kilovoltage, skin dose in r, depth dose in r, integral (absorbed) dose in gram-roentgens, and scattered radiation in mr at 60 cm. distance.

In lateral pelvimetry, at 90 cm. T.S.D. and 78 kv, the skin receives 21 r, while 2.8 r is received by the ovary at 11 cm. depth and 1.1 r by the fetus at 16 cm. depth, the total absorbed dose being (by Mayneord's classic formula) 140,000 gram-roentgens. With an anteroposterior study of the pelvis at 180 kv and 450 cm. T.S.D., the skin dose is reduced to 0.05 r and the integral dose to 500 gram-roentgens.

A barium-meal study, including ten minutes of roentgenoscopy at 3 ma and 70 kv, one four-spot film and four routine roentgenograms at 120 kv, results in 96 r to the skin, 3 r depth dose, and 185,000 gram-roentgens.

The largest doses are incident to angiography: in the frontal projection, thirty exposures (100 kv, 100 cm. T.S.D.) result in 50 r to the skin and 324,000 gram-roentgens, while thirty lateral exposures, with the same factors, give 88.5 r to the skin and 600,000 gram-roentgens, the scattered radiation at 60 cm. distance being 100 mr in the former and 165 mr in the latter.

A lateral chest roentgenogram at 78 kv and 180 cm. T.S.D. delivers 0.1 r to the skin and an integral dose of 660 gram-roentgens, whereas with 130 kv at 189 cm. T.S.D., the skin dose drops to 0.02 r, the integral dose to 170 gram-roentgens.

After recalling numerous experimentally proved facts, as, for instance, that filtration does not spoil the roentgenoscopic image, yet effectively decreases the skin exposure, and that high kilovoltage technics result in less exposure to the patient, the author draws several conclusions: (1) Routine diagnostic roentgenologic procedures will result in exposures to the patient far below today's permissible dosage, provided proper precautions are taken, such as adequate filtration and sufficient target-skin distance in roentgenoscopy. Even in the face of unknown genetic hazards, one must not reject pelvimetry, because of the advantages of its judicious use. (2) The roentgenologist and his aides need not be subjected to dangerous levels of radiation, unless they transgress willfully the rules which have become the accepted routine all over the world. We no longer encounter recently caused necrosis and other obvious skin damage, but there is a higher incidence of leukemia and other sequelae of chronic exposure [who ever decided that aprons do not have to cover the shoulders and extremities?]. These statements do not apply to some general practitioners, orthopedists, and others, who because of ignorance or neglect are subjecting themselves to undue hazards. (3) High kilovoltage technic should be introduced whenever possible, because of the reduced exposure to patients, and, in the case of spot-films, to the operator.

Two tables. I. F. HUMMON, M.D.
Cook County Hospital, Chicago

Professional Radiation Injuries in Medical Practice. Hedi Fritz-Niggli. Schweiz. med. Wchnschr. **86:** 204–208, Feb. 25, 1956.

The author gives a basic discussion of radiobiology and a brief outline of radiation physics. The changes following irradiation, as they affect the eye, skin, blood, and gonads, are described. The great sensitivity of the embryo to radiation is also emphasized. This sensitivity is at its height between the second and sixth week of gestation, when as little as 25 r may produce malformation.

Changes in the blood corpuscles can be induced in animals by prolonged irradiation of only 0.1 r. In man, changes following prolonged weak irradiation below 0.3 r per week are not clear-cut. Radiologists are more frequently afflicted with leukemia than persons not in contact with x-rays. Similarly, survivors of atomic bomb attacks who were exposed to the radiation effects showed an incidence of leukemia eight times as great as those not so exposed.

The greatest danger from irradiation, however, lies in the genetic effects, since these can be transmitted to successive generations. The effects are additive, the damage irreversible, and the time of application seems not to be of importance. While the maximum permissible exposure of 0.3 r per week appears to be safe so far as damage to tissues is concerned, there is no permissible dose to avoid genetic effects. The smallest amount may produce a mutation. It is estimated that 38 to 80 r extended over a lifetime (up to cessation of reproductive capacity) will double the spontaneous rate of mutation. It is imperative, therefore, that the exposure of patients, as well as of the radiologist and his personnel, be reduced to a minimum.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Effects of a Single Session of Whole Body Irradiation in the Rhesus Monkey. Mary V. Haigh and Edith Paterson. Brit. J. Radiol. **29:** 148–157, March 1956. (Christie Hospital, Manchester, England)

The response of Rhesus monkeys (*Macaca mulatta*) to whole-body irradiation was studied over a period of four years. Forty-four male and female monkeys were given single doses of 400 to 650 r. By the probit method of Bliss the thirty-day LD 50 was estimated at 570 r ± 25 r.

The irradiation syndrome was studied in relation to three dose levels, 250 r (50 animals), 500 to 550 r (29 animals), and 600 to 650 r (11 animals). The symptoms during the three weeks following irradiation included loss of appetite, vomiting, diarrhea, and weight loss. Hemorrhages and epilation occurred, and there was a tendency to infections. The occurrence and the severity of these symptoms varied greatly in individual animals and tended to be more severe with the higher doses.

The irradiation effects on peripheral blood were studied by several blood counts before irradiation and subsequent serial counts. The red cell count dropped at a more rapid rate with the larger dosages. With 500 to 650 r the lowest level occurred between seventeen and twenty-six days, with return to a normal range in about ten weeks. Reticulocytes were depressed following irradiation, due to inhibition of erythroblastic activity in the marrow. The duration of this effect was related to the dose.

At all the dose levels an initial but transient rise occurred in the mean neutrophil count after irradiation. Following this rise, there was a decrease to a minimum between fourteen and seventeen days. Recovery was rapid and characterized by waves of very high count.

The eosinophils, unlike the neutrophil leukocytes, showed no immediate post-irradiation rise, nor did they disappear rapidly. After the first twenty-four hours, however, the count closely followed that of the neutrophils; a decrease was evident on the second day and low or absent counts continued for periods varying with the size of the dose. Most animals recovered or surpassed their pre-irradiation counts by the thirty-fifth day.

The lymphocyte count apparently fell immediately after irradiation, since within half an hour of the end of irradiation they showed a highly significant reduction. The amount of fall in the first few days showed only a slight relationship to dose. The time of initial recovery, on the other hand, bore a definite relationship.

A fall in platelets was seen in most animals from about the second day, even with the lower dosage of 260 r. There was considerable individual variation, but the lowest mean figures were reached about the end of the second week. There was only a moderately good correlation between the fall in platelets and occurrence of hemorrhage. The hemorrhagic tendency, therefore, may depend on some other factor than platelet deficiency. In the surviving animals a rise of the platelets began at the end of two weeks.

The radiation syndrome in the monkey is similar to that of other mammals, including man, the differences being chiefly in the degree of severity of individual symptoms. In this study the outstanding symptom was hemorrhage. It was invariable and was more severe and earlier in appearance in the skin and alimentary tract of non-surviving animals at all dose levels.

Various theories have been put forward to explain the true radiation-induced reduction in the various cells of the peripheral blood. This study suggests that radiation inhibits erythropoiesis at the source and that the reduction in reticulocytes may well be an indication of their normal span of activity as reticulocytes in the blood stream. The duration of inhibition is dose-dependent, a dose of 260 r producing a considerably shorter inhibition than one at LD 50. As an index of a good prognosis, an early slight rise in reticulocytes at about the twelfth day post-irradiation is valuable and would seem to be the only reliable indication of survival of an individual.

The poor prognosis indicated by low platelets, early hemorrhages, and a rapidly falling red cell count is apparent when animals are regarded as a group but is of little value in assessing the chances of survival for an individual.

Two photographs; 8 graphs; 1 table.

JOHN F. WEIGEN, M.D.
Palo Alto, Calif.

Time-Intensity Factors in Radiation Response. 1. The Acute Effects of Megavolt Electrons (Cathode Rays) and High- and Low-Energy X-Rays with Special Reference to the Brain. Samuel P. Hicks, Kenneth A. Wright, and Kenneth E. Leigh. With the assistance of Barbara L. Brown and Charlotte E. DeHarport. Arch. Path. **61:** 226–238, March 1956. (S. P. H., Department of Pathology, Harvard Medical School, Boston, Mass.)

Some pathologic and physiologic effects of radiation as observed in mice when the physical factors of dosage, especially the intensity, were varied are reported. The striking functional and anatomic changes in the brain that result from megavolt electrons (cathode rays) were studied in particular. For comparison, the acute effects of x-rays at several voltage levels and at slow and fast rates were investigated.

High-intensity megavolt electrons caused severe brain damage or, in high doses, instant death, by their effect upon the lower medulla. X-rays of high or low voltage were less effective in these respects.

With megavolt electrons, damage to the cerebellar granule neurons began at 5,000 rep and became slightly more evident at 10,000 rep. Maximum damage—necrosis of virtually all the granule cells in an affected area—was sustained by a few animals given a dose of 20,000 rep. X-rays administered at rapid rates produced slight evidence of change at 10,000 r, but damage became more pronounced at 20,000 r. Electrons at 2.5 MEV and 20,000 and 30,000 rep not only caused considerable widespread forebrain damage but occasionally produced patchy regions of necrosis in the white matter, with accompanying destruction of oligodendroglia in the affected zones. X-rays did not exhibit this "demyelinating" effect, although they sometimes produced substantial necrosis of forebrain neurons.

The effects of cathode rays with selective shielding of different parts of the head was studied and the zone of the head and upper neck embracing the caudal half of the medulla was found to be the critical area.

Observations concerning the precise mechanism of death in the irradiated animals are presented. It is concluded that the intensity of the radiation, *i.e.*, the time in which the dose is administered, is an important factor in determining the severity of brain damage.

Six photomicrographs; 1 graph.

On the Spreading Effect of X-Rays as Measured by Intradermal Pressure. H. Certa and H.-J. Heite. Strahlentherapie 99: 583–593, April 1956. (In German) (Hautklinik der Philipps Universität, Marburg 12, Germany)

Previous workers have investigated the spreading effect of x-rays by injection of India ink and other dyes into the irradiated skin. The authors use the measurement of tissue pressure as an indicator of this effect. This method, devised by Yandell Henderson, consists of measuring the minimum pressure necessary to inject physiologic saline into the living tissue.

Guinea-pigs were irradiated through several ports. One port received only x-rays, another x-rays plus Schering-E. Kinetin [a hyaluronidase-like substance], and a third Kinetin alone, while a fourth served as a control. The experiments showed that both agents lowered the intradermal pressure (maximum effect at three hours) and that recovery took place in about twenty-four hours. The pressure rose above normal after the seventh day. When both agents were combined, contradictory effects were observed depending on the time interval between injection and irradiation.

The authors conclude that the mechanism by which x-rays lower the intradermal pressure is different from that whereby the same effect is produced by Kinetin.

[This conclusion disregards Wilder's law of initial values. According to this law, the results are by no means surprising and would have been obtained even had both agents been identical. The findings merely indicate that the first insult makes the tissue temporarily refractory to the second agent.—G.S.S.]

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